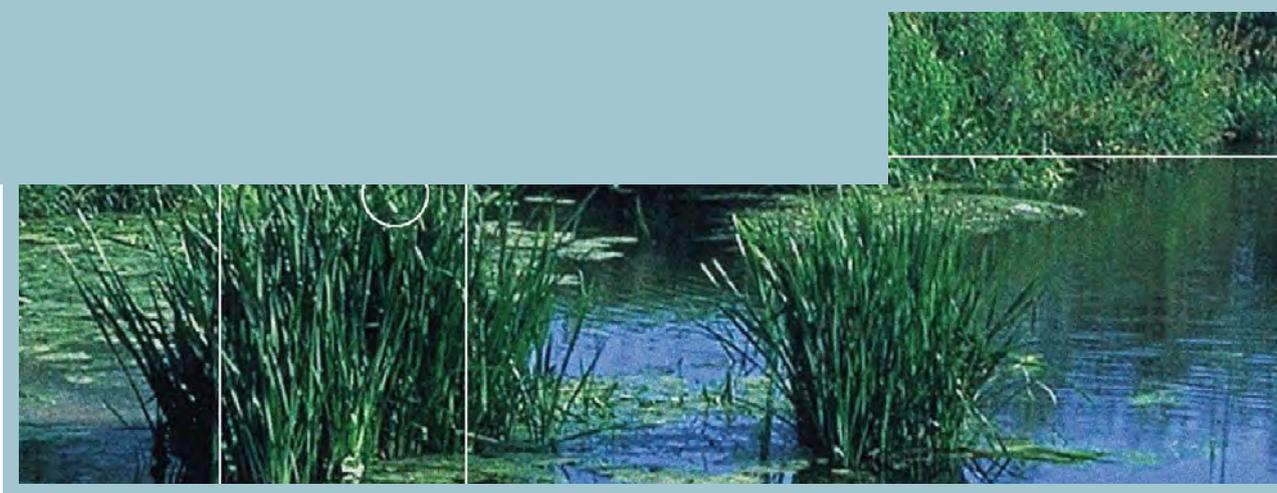


Knowsley Metropolitan Borough Council
Level 2 Strategic Flood Risk Assessment

Volume 1 – Guidance



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Executive Summary

Capita Symonds has been commissioned to prepare a Level 2 Strategic Flood Risk Assessment (SFRA) on behalf of Knowsley Metropolitan Borough Council (KMBC) in order to inform its Local Plan. The assessment builds on the findings of the Level 1 SFRA published in 2009. It has been produced in line with guidance within the National Planning Policy Framework (NPPF) (March, 2012) and the supporting Technical Guidance to the National Planning Policy Framework (March 2012). The purpose of this assessment is to provide more detailed information regarding the nature of flood risk at a number of sites being considered for allocation in Knowsley's emerging Local Plan. It provides information on flood depth, velocity and hazard and identifies appropriate flood risk management measures that could be implemented to manage flood risk at these sites.

The fundamental concepts that underpin the SFRA are incorporated into the NPPF and the Technical Guidance to the National Planning Policy Framework (hereafter referred to as 'the Technical Guidance'). The guidance provided in the NPPF requires local authorities and those responsible for development decisions to demonstrate that they have applied a risk-based, sequential approach in preparing development plans and consideration of flooding through the application of a Sequential Test and, where applicable, an Exception Test. Failure to demonstrate that necessary tests have been undertaken at this level potentially leaves land allocations and decisions on planning applications open to legal challenge. This assessment will assist in facilitating the application of both the Sequential and the Exception Test at the sites being considered for allocation.

The underlying objective of the risk-based sequential allocation of land is to reduce the exposure of new development to flooding and to reduce reliance on built flood defences. Within areas at risk from flooding, it is expected that development proposals will contribute to a reduction in the overall magnitude of the flood risk. SFRAs are therefore essential in enabling a strategic and proactive approach to be applied to flood risk management. This assessment contains a general assessment of risk from all sources over the whole study area before targeting the potential development sites that are considered to be at risk from flooding.

The principal objective of the Level 2 SFRA is to facilitate the application of the Sequential and Exception Tests. More detailed information is required where there is deemed to be development pressure in areas that have a medium or high probability of flooding and where there are no other suitable alternative areas for development after applying the Sequential Test. A Level 2 SFRA considers the detailed nature of the flood hazard, taking account of the presence of flood risk management measures such as flood defences. In doing so it allows a sequential approach to site allocation to be adopted within a flood zone. It will also allow the development of policies to ensure that development in such areas satisfy the requirements of the Exception Test.

Decisions also require the inclusive assessment of wider planning issues and the user should be aware that changes to decision making principles affecting other planning issues can potentially affect the outcome of the risk-based Sequential Test. It is the responsibility of the user to ensure that they are using the best available information.

The SFRA is a live document that is intended to be updated as new information and guidance becomes available. The outcomes and conclusions of the SFRA may not be valid in the event of future changes to legislation, policy or revised government guidance on flood risk. It may also become invalid if the data on flood risk is updated or the baseline flooding situation changes as a result of future flood risk management measures.

This report is Volume 1 of the assessment and it identifies the flood risks within the Borough and provides guidance for different groups of users on the data presented within the SFRA. The supporting mapping is contained within Volume 2 which should be read in conjunction with this report.

Contents

Quality Management.....	i
Executive Summary.....	1
Contents	3
1 Introduction	5
1.1 Background	5
1.2 National, Regional and Local Legislative and Planning Context.....	6
1.3 Knowsley Study Area	15
2 Flooding in Knowsley	17
2.1 Introduction.....	17
2.2 Fluvial Flood Risk	18
2.3 Groundwater Flooding.....	30
2.4 Surface Water and Sewer Flooding	31
2.5 Flooding from Artificial Sources.....	34
2.6 Summary of Flood Risk	37
3 How to use the SFRA in Forward Planning.....	39
3.1 Introduction.....	39
3.2 Sequential Test.....	40
3.3 Exception Test.....	45
4 How to use the SFRA in Development Management.....	49
4.1 Introduction.....	49
4.2 Guidance for Developers.....	49
4.3 Guidance for Knowsley Metropolitan Borough Council.....	54
5 Flood Warning and Emergency Planning.....	67
5.1 Introduction.....	67
6 Policy Guidance and Recommendations	71
6.1 Introduction.....	71
7 SFRA Maintenance and Management	82
7.1 Introduction.....	82
7.2 Data Collection	82
7.3 Data Processing	84
7.4 Data Ownership.....	84
7.5 SFRA data management system	86
7.6 Monitoring the SFRA	87
8 References.....	89

Tables

Table 2-1: Records of fluvial flooding from ordinary watercourses within Knowsley (Source: Knowsley PFRA)	21
Table 2-2: Flood zones defined in Table 1, NPPF	22
Table 2-3: Available hydraulic models.....	24
Table 2-4: Culverts within the Knowsley Borough with the potential for 'daylighting'	28
Table 3-1: How to Apply the Sequential Test	41
Table 3-2: Information available within the SFRA for assessing whether a site is 'safe'	46
Table 6-1: Policy Recommendations for Development Management and Flood Risk Assessments	73
Table 6-2: Recommended Planning Policy Guidance.....	76
Table 7-1: Data Register.....	82
Table 7-2: Key Datasets	84
Table 7-3: Frequency of dataset renewal	88

Figures

Figure 1-1: The Knowsley Level 2 SFRA in context with other plans	13
Figure 3-1: Application of the Sequential Test	41
Figure 3-2: An example case study of allocating a site using the Sequential Test	44
Figure 3-3: Application of the Exception Test.....	45
Figure 3-4: Site-specific aspects to consider with respect to what is 'safe?'.....	48
Figure 4-1: Process for assessing flood risk constraints and FRA scope	56
Figure 7-1: Conceptual SFRA management process.....	87

Appendices

A	Glossary
B	Principal Culverted Watercourses

Volume 2: List of Figures

Figure B1-1	Catchment Overview
Figure B1-2	Catchment Overview
Figure B2-1	EA Flood Zones
Figure B2-2	EA Flood Zones
Figure B3-A-1	Actual Risk Flood Extent
Figure B3-A-2	Actual Risk Flood Extent
Figure B3-A-3	Actual Risk Flood Extent
Figure B3-B-1	Actual Risk Flood Depth
Figure B3-C-1	Actual Risk Flood Velocity
Figure B3-D-1	Actual Risk Flood Hazard
Figure B4-1	Modelled Watercourses
Figure B4-2	Modelled Watercourses
Figure B5-1	EA Flood Map for Surface Water Flooding
Figure B5-2	EA Flood Map for Surface Water Flooding
Figure B6-1	Number of Sewer Related Surface Water Flooding Incidents
Figure B6-2	Number of Sewer Related Surface Water Flooding Incidents
Figure B7-1	Reservoir Flooding
Figure B7-2	Reservoir Flooding
Figure B8-1	LiDAR
Figure B8-2	LiDAR
Figure B9-1	Allocated sites
Figure B9-2	Allocated sites
Figure B10-1	Critical Drainage Areas
Figure B10-2	Critical Drainage Areas
Figure B11-1	Potential Suitability for SuDS
Figure B11-2	Potential Suitability for SuDS

1 Introduction

1.1 Background

- 1.1.1 This Strategic Flood Risk Assessment (SFRA) forms part of an evidence base that will directly inform the preparation of Knowsley Metropolitan Borough Council's (KMBCs) Local Plan. The information within this SFRA will also inform the management of flooding issues within the Borough.
- 1.1.2 In June 2009 KMBC jointly published its Level 1 Strategic Flood Risk Assessment (SFRA)¹ with Sefton Metropolitan Borough Council (SMBC) to inform their respective Local Plans. The Level 1 SFRA provided the information required to apply the Sequential Approach and Sequential Test. This was produced in line with the now superseded Planning Policy Statement 25 – *Development and Flood Risk* (PPS25) (DCLG, 2006)².
- 1.1.3 PPS25 was replaced by the National Planning Policy Framework (NPPF)³ (March 2012), which is supported by Technical Guidance to the National Planning Policy Framework⁴ (the Technical Guidance). These documents maintain the requirement to apply a risk-based, sequential approach to the location of development in order to avoid flood risk to people and property.
- 1.1.4 In April 2012, Capita Symonds was commissioned by KMBC to prepare a Level 2 SFRA on its behalf. The purpose of this assessment is to provide more detailed information regarding the nature of flood risk at a number of sites being considered for future allocation within Knowsley's emerging Local Plan. The assessment will assist in facilitating the application of both the Sequential and the Exception Test at these sites. It will provide more information on flood depth, velocity and hazard and will identify appropriate flood risk management measures that could be implemented to manage flood risk at these sites.
- 1.1.5 The underlying objective of the SFRA is to provide a platform for the consistent consideration of flood risk, incorporation of current best-practice and best available data for the duration of the plan. In preparing this Level 2 SFRA, the opportunity has been taken to obtain up-to-date information on all sources of flooding and to update the information presented in the Level 1 SFRA on flood risk within the Knowsley Metropolitan Borough area. Consideration is given to the risk of flooding over the lifetime of proposed development included within this plan, which is taken to be 100 years for residential development. Consequently

¹ Knowsley Council and Sefton Council Level 1 SFRA, Atkins June 2009.

² Planning Policy Statement 25: Development and Flood Risk, March 2010.

³ National Planning Policy Framework, March 2012.

⁴ Technical Guidance to the National Planning Policy Framework, March 2012.

the currently understood effects of climate change, as described in the Technical Guidance and other relevant guidance, have been adopted when assessing risk over these timescales.

1.1.6 This document is the Level 2 SFRA Volume 1 – Guidance. It outlines the existing sources and risk of flooding within the study area and provides a summary of the background and methodology adopted for assessing flood risks at the strategic scale. It also provides a user-guide element, describing how the document should be used by various functions within the council. Volume 1 should be read in conjunction with Volume 2 – Mapping and Assessments of Key Development Sites.

1.1.7 This remainder of this document has been broken into the following chapters:

Chapter 2: Flood Risk in Knowsley – a summary of the flood risk in the Borough from all sources, outlining the data that is available and that which is used in the site assessments;

Chapter 3: How to use the SFRA in Forward Planning – Explains how Knowsley Metropolitan Council should use the SFRA to support its strategic land use planning function, including an explanation of the application of the Sequential Test and Exception Test;

Chapter 4: How to use the SFRA in Development Management – this chapter identifies the role of the SFRA in identifying the need for an FRA and the level of detail required within an FRA when one is required;

Chapter 5: How to use the SFRA in Emergency Planning – this chapter advises on the responsibilities of Knowsley Metropolitan Council with regard to emergency planning and outlines how the SFRA can be used to support this function;

Chapter 6: Policy Recommendations – this chapter presents policy recommendations that have been developed on the basis of current National planning policy, Environment Agency recommendations and on the strategic assessment of flood risk across the Borough presented in Chapter 2;

Chapter 7: SFRA Maintenance and Management – provides advice on how to keep the SFRA technical and policy information up to date; and

Chapter 8: References

1.2 National, Regional and Local Legislative and Planning Context

Flood and Water Management Act, 2010

1.2.1 Combined with the Flood Risk Regulations 2009, (which enact the EU Floods Directive in the England and Wales) the Flood and Water Management Act 2010 places significantly greater responsibility on Local Authorities to manage and lead

on local flooding issues. The Act and Regulations together set out the requirements and targets Local Authorities need to meet, including:

- Playing an active role leading flood risk management;
- Development of Local Flood Risk Management Strategies (LFRMS);
- Preparation of preliminary flood risk assessments, flood hazard maps, flood risk maps and flood risk management plans;
- Development and implementation of drainage and flood risk management strategies; and
- Responsibility for approval, followed by adoption, management and maintenance of Sustainable Drainage System (SuDS).

1.2.2 The Flood and Water Management Act also clarifies three key areas that influence development:

- Sustainable drainage (SuDS) - the Act makes provision for a national standard to be prepared on SuDS. Developers will be required to obtain local authority approval for the SuDS in accordance with the standards, likely with conditions. When designed and constructed robustly, local authorities will be required to adopt and maintain the SuDS.
- Flood risk management structures - the Act enables the EA and local authorities to designate structures such as flood defences or embankments owned by third parties for protection if they affect flooding or coastal erosion. A developer or landowner will not be able to alter, remove or replace a designated structure or feature without first obtaining consent.
- Permitted flooding of third party land - The EA and local authorities have the power to carry out work which may cause flooding to third party land where the works are deemed to be in the interest of nature conservation, the preservation of cultural heritage or people's enjoyment of the environment or of cultural heritage.

National Planning Policy Framework (NPPF)

1.2.3 The National Planning Policy Framework⁵ was issued in March 2012 and outlines the national policy including on development and flood risk assessment. This replaced with immediate effect national policy including Planning Policy Statement 25 – Development and Flood Risk.

1.2.4 The NPPF requires Local Plans to be supported by a Strategic Flood Risk Assessment and develop policies to manage flood risk from all sources. Advice

⁵ National Planning Policy Framework (DCLG, 2012)

should be sought from the Environment Agency and other relevant flood risk management bodies, such as Lead Local Flood Authorities (LLFAs) and Internal Drainage Boards (IDBs). In developing policies, Local Plans should apply a sequential, risk-based approach to the location of development in order to avoid flood risk to people and property, to manage any residual risk, and to take account of the impacts of climate change.

1.2.5 In general, these requirements will be met by:

- Applying the Sequential Test and where appropriate and necessary the Exception Test;
- Safeguarding land from development that is required for current and future flood risk management;
- Using opportunities offered by new development to reduce the causes and impacts of flooding; and
- Seeking opportunities to facilitate the relocation of development, including housing, to more sustainable locations where climate change is expected to increase flood risk to existing development.

1.2.6 Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower probability of flooding. The SFRA will be the basis for applying this test and a sequential approach should be used in areas known to be at risk from any form of flooding.

1.2.7 Following application of the Sequential Test, if it is not possible for the development to be located in zones with a lower probability of flooding, the Exception Test can be applied. It should only be applied if appropriate to the type of development and flood zone and if consistent with wider sustainability objectives.

1.2.8 For the exception test to be passed it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA. It must also be demonstrated within a site specific FRA that the development will be safe for its lifetime without increasing flood risk elsewhere and where possible reducing flood risk.

1.2.9 When determining planning application, Local Planning Authorities should ensure that flood risk is not increased elsewhere and should only consider development in areas at risk from flooding where it can be demonstrated that a sequential approach has been taken, that the development is appropriately flood resilient, that residual risks can be managed and that priority is given to the use of sustainable drainage systems.

Technical Guidance to the National Planning Policy Framework

- 1.2.10 The Technical Guidance to the National Planning Policy Framework⁶ provides additional guidance to Local Planning Authorities to ensure the effective implementation of the planning policy set out in the National Planning Policy Framework on development in areas at risk of flooding. The guidance retains key elements of the now superseded PPS 25.
- 1.2.11 The document provides supporting information on:
- The definition of Flood Zones;
 - Flood risk vulnerability of different land uses;
 - The application of the sequential approach and Sequential and Exception Tests;
 - Flood risk assessment at the strategic and site level; and
 - Climate change and managing residual risks.
- 1.2.12 The Technical Guidance clarifies that the SFRA refines information on the probability of flooding by taking into account information on other sources of flooding and, where information is available, the effect of climate change. The document also clarifies that the SFRA should support the Local Plan, should be prepared in consultation with the Environment Agency, a Local Planning Authorities' own emergency planning and drainage functions and any internal drainage boards. The SFRA should also inform appropriate flood risk management policies, the sustainability appraisal of the development plan documents and will form the basis of applying the Sequential and Exception Test in the development allocation and development control process.

North West Regional Spatial Strategy

- 1.2.13 The North West's Regional Spatial Strategy⁷ is the development plan document that sets out regional spatial strategies and policies within which sub-regional and local planning policy should be developed. The Government, however, has expressed its intention to revoke Regional Spatial Strategies.
- 1.2.14 Policy DP2 of the RSS (Promote Sustainable Communities) indicates that flood risk is one of a number of safety and security issues to consider and Policy DP9, Reduce Emissions and Adapt to Climate Change, identifies increased storminess and flood risk as one of the consequences of climate change that will need adaptation measures to be applied.

⁶ Technical Guidance to the National Planning Policy Framework (DCLG, 2012)

⁷ North West of England Plan – Regional Spatial Strategy to 2021 Employment Land Implementation Note – April 2009 (4NW, 2009)

- 1.2.15 The RSS identifies that flood risk should be one of the factors considered when considering coastal development.
- 1.2.16 Policy EM5 (Integrated Water Management) indicates that plans and strategies should have regard to River Basin Management Plans (RBMPs), Water Company Asset Management Plans (AMPs), Catchment Flood Management Plans (CFMPs) and the Regional Flood Risk Appraisal (RFRA). Local planning authorities and developers should protect the quantity and quality of surface water, groundwater and coastal waters and manage flood risk. This can be achieved by working with the United Utilities and the Environment Agency when phasing and locating new development, by producing a strategic flood risk assessment, guided by the RFRA, by requiring new development to meet the requirements of the sequential test and exception test, by designing appropriate mitigation measures, incorporating SuDS and raising peoples awareness.

Knowsley Replacement Unitary Development Plan

- 1.2.17 The Knowsley Replacement UDP⁸ was adopted in June 2006, however, in June 2009 under the transitional arrangements for moving towards the Local Development Framework (LDF) the Secretary of State saved all but four of the 82 policies..
- 1.2.18 Policy ENV7: Development and Flood Risk was saved and will remain in place until such time as new policies within the Local Plan are adopted. Policy ENV7 states that:
- Development at an unacceptable risk of flooding will not be permitted. Where a development would be within an area of flood risk, the applicant will be required to:
 - submit evidence to establish that the development could not be practicably located within an area of lower or no flood risk.
 - submit a flood risk assessment, which will fully assess the risks of flooding associated with the development in accordance with the requirements of Planning Policy Guidance note 25 "Development and Flood Risk".
 - Development will not be permitted if it may cause an unacceptable risk of flooding elsewhere.
 - Mitigation measures will be required, where necessary, to manage flood risk associated with or caused by new development. These should;
 - Be derived from a flood risk assessment;

⁸ Knowsley Replacement Unitary Development Plan (Knowsley MBC, 2006)

- Be fully described in the planning application;
 - Be fully funded - including for the provision of long-term maintenance - as part of the development; and
 - Contribute to the biodiversity resource of the Borough.
- New development will not be permitted unless a Sustainable Drainage System is incorporated into the overall design. Exceptions may be made where it can be demonstrated that:
 - The Sustainable Drainage System would be likely to cause either significant land or water pollution; or
 - The site's ground conditions would preclude the use of a Sustainable Drainage System; or
 - The size of the site precludes the use of a Sustainable Drainage System; or
 - The proposed Sustainable Drainage System could cause damage to adjacent buildings or sites.

Knowsley Local Development Framework Core Strategy: Preferred Options Report

- 1.2.19 The Preferred Options report⁹ indicates that approximately 306ha of land within Knowsley has a medium or high risk of flooding. The majority of the areas are in the Green Belt with just over 1% of properties in the urban area being affected. As a result, it is identified that flood risk is one of a number of issues to consider when locating new development.
- 1.2.20 Preferred Option CS 2: Development Principles indicates that there should be no negative impact on flood risk from new development.
- 1.2.21 Preferred Option CS 8: Green Infrastructure indicates that protection of green infrastructure will help to mitigate the effects of climate change and flood risk. Managing flood risk, including the use of Sustainable Drainage Systems and flood resilient design for infrastructure and property is recognised as being one facet of sustainable construction and development (Preferred Option CS 22).
- 1.2.22 Preferred Option CS 24: Managing Flood Risk indicates that the Council will ensure that new development will reduce the extent and impact of flooding on site and will not result in an unacceptable flood risk elsewhere. This is to be achieved by:
- directing development to areas with a low probability of flooding and, where appropriate requiring developers to demonstrate that development could not

⁹ Knowsley Local Development Framework Core Strategy Preferred Options Report (Knowsley MBC, 2011)

be located in areas at lower risk elsewhere;

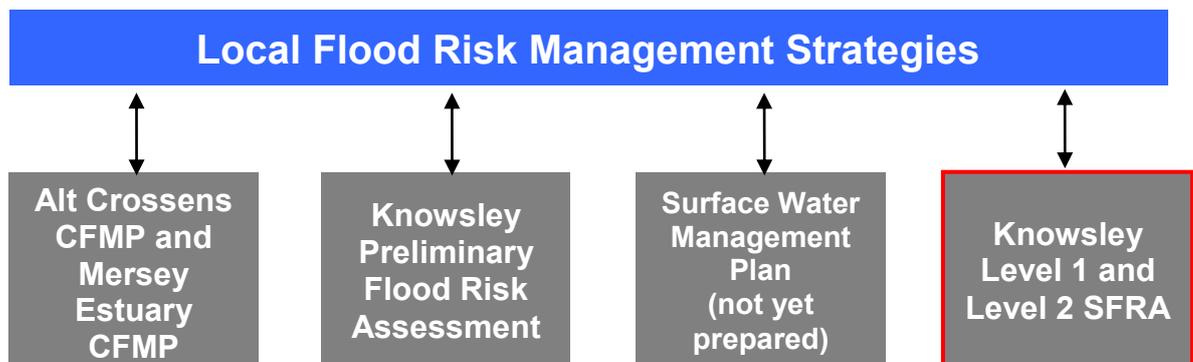
- requiring a flood risk assessment in areas of high or medium flood risk and where the development area is greater than 1ha;
- require mitigation measures to manage flood risks associated with or caused by the development. This should be in line with the SFRA, relevant FRAs or the Local Flood Risk Management Strategy (LFRMS). Mitigation measure should also be fully described in planning applications and be funded as part of the development; and
- requiring that new development use sustainable drainage systems (SuDS) to significantly reduce surface water runoff rates and volumes to Greenfield levels, unless it would be impractical to do so due to the size of a site, contamination or the potential to damage adjacent buildings or sites.

1.2.23 The Local Plan policy, based on Preferred Option CS 24, will replace ENV7 – Flood Risk and Drainage from the saved UDP policies when the Local Plan is adopted.

Local Flood Risk Management Strategies

1.2.24 Both the Level 1 and Level 2 SFRA for KMBC are important tools in guiding the development of planning policies and when making land use decisions. The SFRAs also link to a number of documents, described below. The nature of these links is presented in Figure 1-1, overleaf.

1.2.25 The Flood and Water Management Act 2010¹⁰ (FWMA) requires each Lead Local Flood Authority (LLFA) to produce a Local Flood Risk Management Strategy (LFRMS). The LFRMS must be consistent with the national strategy produced by the Environment Agency. It should make an assessment of the flood risk and plans and actions for managing the risk. It should include local organisations with responsibility for flood risk in the area and partnership arrangements.



¹⁰ Flood and Water Management Act, April 2010.

Figure 1-1: The Knowsley Level 2 SFRA in context with other plans

1.2.26 The Catchment Flood Management Plans (CFMP), Preliminary Flood Risk Assessment (PFRA) and the Level 1 and 2 SFRA for KMBC and the associated risk maps will contribute towards the necessary evidence base to support the development of a Local Flood Risk Management (LFRM) strategy for Knowsley. There is currently no Surface Water Management Plan (SWMP) for KMBC, however, the LFRM may identify the need for a SWMP in some locations.

Preliminary Flood Risk Assessment (PFRA)

1.2.27 These are required as part of the Flood Risk Regulations 2009, which implement the requirements of the European Floods Directive (2007/60/EC). Knowsley, as the Lead Local Flood Authority (LLFA), prepared a Preliminary Flood Risk Assessment in June 2011¹¹.

1.2.28 The assessment gives an overview of all current and future local sources of flood risk, i.e. surface water, groundwater, ordinary watercourses and artificial sources. It does not cover flooding from main rivers, the sea or large reservoirs, which remain the overall responsibility of the Environment Agency. LLFAs must review these PFRAs every 6 years.

1.2.29 The PFRA also provides a summary of historic floods that are considered or known to have had significant harmful consequences. In Knowsley, significant local consequences were defined as an event that impacted 20 people or approximately 8 houses. However, the historical flooding records data collected as part of the PFRA did not provide enough detail to allow a full assessment of the impact and consequences on the residents of the properties flooded. The evidence available, therefore, suggests that past flooding events within Knowsley are not considered to be locally significant and in light of this no significant events were recorded in the PFRA.

1.2.30 Future flood risk predominantly considered two national datasets, Areas Susceptible to Surface Water Flooding (AStSWF) and Flood Map for Surface Water (FMfSW). As with some of the other council areas within the North West, KMBC adopted the FMfSW as representative of surface water flooding within its area. In total 3,000 properties were identified as being at risk of flooding during a 1 in 200 year rainfall event of which 2,400 are residential and 600 were non-residential properties.

Alt Crossens Catchment Flood Management Plan (CFMP)

1.2.31 The Alt Crossens Catchment Flood Management Plan (CFMP)¹² gives an

¹¹ Knowsley PFRA, Knowsley MBC June 2011.

¹² Alt Crossens CFMP Summary, Environment Agency, December 2009.

overview of flood risk in the Alt Crossens catchment and sets out the Environment Agency's plan for sustainable flood risk management over the next 50 to 100 years. The upper Alt and a number of its tributaries, such as Kirkby Brook and Knowsley Brook, fall within the Alt Crossens catchment.

- 1.2.32 The CFMP highlights that some flooding from rivers does occur, mainly as a result of channel capacity and channel constrictions. In the future, by 2100, it is estimated that the number of properties at risk would rise due to the effects of climate change.
- 1.2.33 The Policy Unit for this area is known as the Liverpool Policy Unit and the preferred policy (Policy 4) is to possibly take further actions to keep pace with climate change in area at low, moderate or high flood risk.

Mersey Estuary Catchment Flood Management Plan (CFMP)

- 1.2.34 The Mersey Estuary CFMP¹³ gives an overview of flood risk in the Lower Mersey and the Mersey Estuary and sets out the Environment Agency's plan for sustainable flood risk management over the next 50 to 100 years. A number of watercourses, including Prescott Brook, Dog Clog Brook, Ochre Brook, Mill Brook, Netherley Brook and Ditton Brook fall, within the Mersey Estuary CFMP area.
- 1.2.35 The CFMP highlights that flood risk is generally low and concentrated in rural areas, though there are approximately 563 properties at risk in a 1% AEP flood event along with up to 6km of transport infrastructure and seven vulnerable receptors¹⁴, though the precise nature of these receptors is not identified. Huyton is identified as one of a number of areas with sewer flooding issues and there are areas in the south identified as being at risk from groundwater rebound¹⁵. Flood defences are identified that provide localised protection to Netherley, there are maintained channels that provide protection to 41 properties and a pumping station exists on Dog Clog Brook for land drainage purposes that is currently under review for decommissioning. In the future, by 2100, it is estimated that the number of properties at risk would rise due to the effects of climate change and development.
- 1.2.36 The Policy Unit for this area is known as the Knowsley Policy Unit and the preferred policy (Policy 2) is to reduce existing flood risk management actions, accepting that flood risk will increase over time.

¹³ Mersey Estuary CFMP Summary, Environment Agency, December 2009.

¹⁴ Vulnerable receptors are types of property or land use that are particularly vulnerable to flooding. The consequences of flooding to vulnerable receptors may have wider effects on human health, the economy or the environment.

¹⁵ Groundwater rebound is the term given local or regional groundwater levels that rise back to natural levels as a result of the cessation of activities that had lowered the groundwater level, such as groundwater pumping associated with mining or abstraction of water for use in industrial processes. Because groundwater levels have often been artificially controlled for long periods of time there is risk to vulnerable infrastructure built in the intervening time period.

Regional Flood Risk Appraisal (RFRA)¹⁶

- 1.2.37 This was produced by 4NW in 2008 and gives a regional overview of flooding from all sources. Given the Government's intention to revoke Regional Spatial Strategies (RSS) at an early date, which the RFRA supported as an evidence base, it is unlikely that the RFRA will be updated.

1.3 Knowsley Study Area

Study Area

- 1.3.1 Knowsley Metropolitan District is situated between Liverpool District to the west and St. Helens to the east. To the north west lies Sefton MBC, to the north east lies West Lancashire and to the south lies Halton District. The district covers approximately 86.5km² and contains the urban centres of Kirkby, Prescott, and Huyton along with the smaller urban areas of Whiston, Halewood, Cronton, Knowsley Village and Stockbridge Village. Approximately 54% of the Borough is designated as Green Belt.
- 1.3.2 The M62 cuts across the lower third of the Borough. The M57 extends from mid-way across the Borough from the M62 in a north and north western direction and passes between Huyton and Prescott and then runs along the western edge of Kirkby. Other significant infrastructure includes the A5300, A561 and A562 to the south of the M62, and the A57, A58 and A580 to the north of the M62. There are also railway lines from Liverpool via Halewood to Widnes, Warrington and Manchester in the south of the Borough, lines through Huyton, Whiston and Prescott to Preston and Manchester, a line from Liverpool to Kirkby and a line from Kirkby to Wigan.

Geology

- 1.3.3 The solid geology of Knowsley consists predominantly of sandstones of the Sherwood Sandstone Group, covering the majority of the lower third and the western half of the Borough. The remainder is located in the north and east and this consists of occasionally minable coal seams from the coal measures. There are also isolated areas of sandstone and mudstone of the Warwickshire Group and other sandstones within the Borough.
- 1.3.4 North of the settlement of Knowsley the overlying drift deposits are typically sand, though there are pockets of till, whilst to the south of the Borough the drift geology is dominated by till with little to no sand. There are isolated areas of sands and gravels on the eastern boundary to the east of Prescott and along

¹⁶ North West RSS Regional Flood Risk Appraisal, October 2008.

watercourses there may be Alluvium.

- 1.3.5 The sand drift would be expected to exhibit a high level of infiltration resulting in a muted catchment response to rainfall events, though this will be affected by groundwater levels and the topographical gradients at that location. Till deposits would be expected to result in less infiltration and more runoff, however topography and groundwater levels play a significant role. Sandstones and coal measures are not typically highly permeable, though there is often large scale permeability through fissures and the Sherwood Sandstone is a major aquifer. Groundwater may therefore provide a reasonable proportion of base flow to the watercourses in this area.

Topography

- 1.3.6 The topography of Knowsley varies from land at or near to sea level to land above 75m sea level. A ridge of high ground runs along the eastern boundary of Knowsley, with a spur of low hills extending from this ridge in a westward direction across the centre from Prescott to Huyton. This spur is not continuous, as the hills are split by the channel of Logwood Brook/Prescot Brook.
- 1.3.7 To the south of these low hills lies the lowest land, which sits within the Ditton Brook catchment and this is bordered to the east by Ditton on higher ground and to the west by Halewood, also on higher ground. To the north of the low hills, low lying land is located along the River Alt, which runs along the north western boundary of the Borough.

Population

- 1.3.8 The current population of Knowsley Borough stands at around 151,000 in 61,000 households. Over the last 20 years the population has fallen, but the rate of decline has been slowing. Government projections suggest that the Borough's population will decline by 3% to around 154,200 by 2028.

2 Flooding in Knowsley

2.1 Introduction

2.1.1 The primary source of flood risk in Knowsley is fluvial flooding. The River Alt is the primary watercourse flowing through the north of Knowsley and it is fed by a number of tributaries. Overall flooding is confined to the fringes of most of the urban areas and the rural parts of the Borough. Development in the Borough has historically avoided extensive culverting and the rivers have retained an open corridor which has meant that there has been space within the floodplain for water to occupy without significant impact to properties and for adaptation to change.

2.1.2 Five key sources of flooding are considered in this SFRA:

- Flooding from rivers and watercourses;
- Flooding from groundwater;
- Flooding from surface water;
- Flooding from sewers; and
- Flooding from artificial sources (docks, canals, reservoirs, lakes).

2.1.3 Figure B1 in Volume 2 of this SFRA presents the Knowsley Metropolitan Borough site boundary and identifies the key hydrological features that are considered within this study.

2.1.4 The Level 1 SFRA contains valuable information about the different sources of flooding. This data has been used along with new datasets that have become available since the release of the Level 1 SFRA in June 2009 in the following chapter of this report. These additional datasets are identified below:

- Flood Zone Map v5, Environment Agency, 2012;
- Areas Susceptible to Surface Water Flooding (ASStSWF), Environment Agency, 2012;
- Flood Map for Surface Water (FMfSW), Environment Agency, 2012;
- Knowsley Preliminary Flood Risk Assessment, Knowsley Metropolitan Borough Council, 2011;
- Reservoir Inundation Mapping, Environment Agency, 2012;
- United Utilities sewer and water flooding records, 08/05/2012;
- LiDAR, Environment Agency via KMBC, 2012;

- Childwall Brook Hydraulic Modelling data (Environment Agency, 2008);
- Court Hey Brook Hydraulic Modelling data (Environment Agency, 2009);
- Ditton Brook Hydraulic Modelling data (Environment Agency, 2008);
- Logwood Mill Brook Hydraulic Modelling data (Environment Agency, 2012);
- Netherley Brook and Halewood Brook Hydraulic Modelling data (Environment Agency, 2012);
- River Alt Strategy Hydraulic Modelling data (Environment Agency, 2011);
- National Flood and Coastal Defence Database (NFCDD) data (11/05/2012); and
- Data on structures along and within the watercourse (11/05/2012).

2.2 Fluvial Flood Risk

Sources

2.2.1 Flooding from rivers occurs when water levels rise higher than bank levels, causing floodwater to spill across adjacent land (the floodplain). The main reasons for water levels rising in rivers are:

- Intense or prolonged rainfall causing runoff rates and flows to increase in rivers, which then exceeds the capacity of the channel. This can be exacerbated by wet conditions leading up to the prolonged rainfall and where there are significant contributions of groundwater;
- Constrictions in the river channel, reducing capacity and causing flood water to backup, i.e. culverts, bridges, pipe-crossings etc;
- Blockage of structures or the river channel causing flood water to backup; and
- High water levels and/or locked flood gates preventing discharge at the outlet of a tributary into a river.

2.2.2 The consequence of river flooding depends on how hazardous the flood waters are and the nature of the receptor¹⁴. Vulnerability varies by land use, for example a Care Home or a children's nursery would be considered to be highly vulnerable to flooding, whilst a commercial property might be considered to be less vulnerable. Further guidance on vulnerability classifications can be found within the Technical Guidance to the National Planning Policy Framework⁴.

2.2.3 The hazard posed by floodwater is proportional to the depth of flooding, the

velocity of flow, the speed of onset of flooding and duration. Flood hazard can therefore vary greatly throughout catchments and even across floodplain areas. Hazardous river flows can pose a significant risk to exposed people, property and infrastructure. Lower hazard flooding can be less of a risk to life, by virtue of being shallower or with low velocity. It can, however, disrupt communities, require significant post-flood cleanup and can cause costly and possibly structural damage to property.

- 2.2.4 Knowsley lies at the head of the River Alt catchment, which rises in Huyton. It is in culvert along Salerno Drive and then open channel through Woolfall Heath where it is met by two unnamed drains that drain areas bordering the M57. It then leaves the Borough west of Stockbridge Village and flows through Croxteth Country Park before meeting Fazakerley Brook north of the sewage works before it re-enters the Borough in the northwest corner of Gillmoss Industrial Estate. It then flows for approximately 1.2km through Kirkby Golf Course before finally leaving the Borough at the weir slightly north of Hancocks Bridge.
- 2.2.5 Knowsley Brook is a significant tributary of the River Alt that drains the predominantly rural area to the west of the settlement of Knowsley Village, which includes parts of the Knowsley Hall Estate. The watercourse has two branches, the southern branch (Mill Brook) rises in Berry Hill and the northern branch rises close to Coopers Moss Farm on Cut Lane. Both branches meet at Ainsworth Lane west of Knowsley Business Park. Knowsley Brook then flows for approximately 1.9km meeting the River Alt at Willow Bed Plantation.
- 2.2.6 Croxteth Brook meets Knowsley Brook in Gillmoss and prior this it flows in open channel along the Knowsley boundary and Croxteth in Liverpool. A number of small watercourses drain westwards from the settlement of Knowsley Village and to the north of Stockbridge Village meeting the Croxteth Brook, including Flukers Brook.
- 2.2.7 Kirkby Brook is another significant tributary of the River Alt and it drains an area to the north of Kirkby. Rising in rural Kirkby Moss and flowing in culvert under Knowsley Industrial Park, it then meets the Simonswood Brook, changing direction to flow south in open channel through Millbrook Park and Valley Park before flowing under the M57 to meet the River Alt approximately 100m upstream of the confluence with the Knowsley Brook. Simonswood Brook is a much larger watercourse that drains the area to the north of the Borough. It follows the northern Knowsley boundary flowing around the Tower Hill urban area before meeting Kirkby Brook.
- 2.2.8 In the south of the Borough the principal catchment is that of Ditton Brook. The source of Ditton Brook is just upstream of Mizzy Dam, located in Knowsley Park

near Knowsley Hall Estate. Mizzy Dam then becomes Prescott Brook, which bisects Huyton and Prescott as it drains southwards but becomes Logwood Mill Brook as it approaches the M62 to the south of Huyton. South of the M62, the watercourse becomes Chapel Brook and is joined by a number of tributaries, including Fox's Bank Brook. South of this the watercourse is known as Ochre Brook and it flows southwards for approximately 1km before being met by Dog Clog's Brook and turning to flow westwards. Fox's Bank Brook and Dog Clog Brook both drain the low lying area to the east of the A5300 that lies between Whiston and Rainhill in the north and Ditton in the south.

- 2.2.9 Now flowing westwards, Ochre Brook becomes Mill Brook when joined by another tributary from the north before joining Netherley Brook to the east of Netherley. At this point Netherley Brook drains an area to the north west that overlaps both Liverpool District and Knowsley as far north as the M62. At its source, Netherley Brook is known as Court Hey Brook and then becomes Childwall Brook. Downstream of its confluence with Mill Brook, flowing in a south easterly direction, Netherley Brook is joined by a tributaries from the west that drain the land between Netherley to the north and Halewood to the south, and from the east that drains the land to the west of Ditton and between Dog Clog Brook in the north and Ditton Brook to the south. Netherley Brook then becomes Ditton Brook to the east of Halewood where it continues to drain to the south east to pass beneath the A562 and out of Knowsley Borough into Halton District.

Historic Records

- 2.2.10 There is a relatively limited history of fluvial flooding in the Borough. A review of the Environment Agency's historic flood map data set indicates a small amount of flooding on Ditton Brook in the south of the Borough, however the majority of the flooding occurred outside of the Knowsley boundary. There is no additional information about when this occurred or the flooding mechanisms involved within the attributes of this EA dataset. An internet search, however, revealed tidal flooding at the downstream end of Ditton Brook in February 2009 may have been the cause. There was flooding in 1990 identified by the Mersey Estuary CFMP.
- 2.2.11 The Alt Crossens CFMP¹² does not identify any specific fluvial flooding events within the upper Alt or its tributaries; however, it does indicate that Kirkby Brook and Simonswood Brook are areas identified to be at risk. The Mersey Estuary CFMP¹³ also indicates that Netherley Brook was recorded to have flooded three times between 1998 and 2005 though no more specific information is available.
- 2.2.12 The Knowsley PFRA¹¹ presents the following table of fluvial flooding records from ordinary watercourses within the Knowsley area, all on Kirkby Brook.

Table 2-1: Records of fluvial flooding from ordinary watercourses within Knowsley (Source: Knowsley PFRA)

Date flooding reported	Location	Sewer Type	Outfall	Chance of rainfall happening in any year	Consequence
Nov 2000	Kirkby	Culverted Watercourse	River Alt	Not Known	Highway Flooding
Feb 2005	Kirkby	Culverted Watercourse	River Alt	Not Known	Highway Flooding
Jan 2008	Kirkby	Culverted Watercourse	River Alt	Not Known	Highway Flooding
Oct 2010	Kirkby	Culverted Watercourse	River Alt	Not Known	Highway Flooding
Jan 2011	Kirkby	Culverted Watercourse	River Alt	Not Known	Highway Flooding
Feb 2011	Kirkby	Culverted Watercourse	River Alt	Not Known	Internal flooding to one property

2.2.13 Flow and level data is also available from the Environment Agency's HiFlows-UK website for the Alt at Kirkby flow and stage monitoring gauge (Gauge Ref: 69032). This is located at NGR 339180, 398340 on the boundary of Knowsley and is operated by the Environment Agency. A review of the annual maximum series, which identifies the highest flow within each water year (1st October to 30th September), indicates that the highest recorded flow at the gauge was approximately $31\text{m}^3\text{s}^{-1}$ recorded on 10th August 2004. Prior to this the highest recorded flow had been of $26\text{m}^3\text{s}^{-1}$ on 10th August 1971, followed by two events of nearly $25\text{m}^3\text{s}^{-1}$ in successive water years, on 30th October 2000 and 9th September 2002. It is not known whether these events caused flooding anywhere, however, they do not coincide with records presented in the PFRA¹¹ for Kirkby Brook or those within the Mersey Estuary CFMP¹³ for Ditton Brook.

2.2.14 A review of the Chronology of British Hydrological Events website, managed by University of Dundee, and an internet search were also carried out for other historical fluvial flooding information but no results were found within the Borough of Knowsley.

Flood Zones

2.2.15 Current national planning policy defines three distinct flood zones, 1, 2 and 3, with further sub-classification of Flood Zone 3 into Flood Zone 3a and Flood Zone 3b.

2.2.16 Table 2-2, provides detail of how each flood zone is defined. It is important to

note that Flood Zones do not consider the presence of flood defences or other flood risk management infrastructure.

Table 2-2: Flood zones defined in Table 1, NPPF

Flood Zone	Definition
Flood Zone 1. Low probability	Land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (< 0.1% AEP)
Flood Zone 2. Medium probability	Land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% to 0.1% AEP) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% to 0.1% AEP) in any year.
Flood Zone 3a. High probability	Land assessed as having a 1 in 100 or greater annual probability of river flooding (> 1% AEP) or a 1 in 200 or greater annual probability of flooding from the sea (> 0.5% AEP) in any year.
Flood Zone 3b. Functional floodplain	Land where water has to flow or be stored in times of flood. SFRAs should identify this Flood Zone (land which would flood with an annual probability of 1 in 20 (5% AEP) or greater in any year or is designed to flood in an extreme (0.1% AEP) flood.

2.2.17 This assessment has obtained the latest Environment Agency Flood Zones, which explicitly identify Flood Zones 2 and 3 and therefore, by omission, also identify those areas that lie within Flood Zone 1. Figure B2 in Volume 2 of this SFRA presents the extent of the Environment Agency's Flood Zones 2 and 3 throughout the study area.

2.2.18 Within Knowsley, Flood Zone 3 is predominantly confined to rural parts of the Borough and/or to wide river corridors that allow flood waters to spill out in times of flood. The areas generally affected by Flood Zone 3 are:

- Halewood Village — flooding from Netherley Brook / Ditton Brook;
- Court Hey Brook causes flooding in adjacent areas of Bowring park and areas by the National Wildflower Centre;
- Knowsley Brook around Shrogs Farm and the A57;
- Settlements along Dog Clog Brook;
- Properties in the north of Tower Hill from Simonswood Brook;
- Settlements along Fox's Bank Brook; and
- Allotments gardens and properties along Prescott Brook in Stadt Moers Park.

- 2.2.19 Flood Zone 2 is slightly more extensive, particularly along the right bank of Croxteth Brook within Knowsley and around the confluence of the Croxteth Brook and Knowsley Brook and also along parts of the floodplain of the River Alt between Huyton and Stockbridge Village.
- 2.2.20 Flood Zones are updated nationally on a quarterly basis within the Environment Agency, though this will only result in a change to Flood Zones within Knowsley when new data is available, for example from detailed hydraulic modelling studies or when existing flood zones have been challenged by a developer or a Local Authority. In light of this, it is recommended that KMBC regularly discuss potential changes to the Flood Zones within its area Development Quality should verify the extents presented within Figure B2 by checking the Flood Map available on the Environment Agency's website.

Actual Risk

- 2.2.21 When referring to Flood Zones, which do not take into account defences, the classification presented in Table 2-2 is used. When referring to the actual flood risk, i.e. that taking into account the presence of defences and assuming that they are of good condition and remain operational during a flood event, then a probability is used to describe the severity of the event.
- 2.2.22 The probability of flooding is described in this SFRA using the term Annual Exceedance Probability (AEP). This is sometimes known as the 'annual probability' of flooding, for example a flood event described as a 1% AEP has a 1% chance of occurring in any given year. This could alternatively be described as a 1 in 100 year return period flood event, i.e. a storm that has a 1 in 100 or 1% chance of happening in any given year.
- 2.2.23 The actual risk of flooding within Knowsley has been assessed using available hydraulic model data for a 1% AEP flood event assuming that all the formal and defacto defences are in place and that they are fully maintained and operational. The following table sets out what additional hydraulic modelling information is available.

Table 2-3: Available hydraulic models

Hydraulic Model Name	Upstream Grid Reference	Downstream Grid Reference	Modelled Length (m)	Date Modelled	Model Type	Return Periods Modelled	Used	Comment
Childwall Brook	342005, 390019	344718, 388248	3,729	2008	HEC-RAS, JFLOW	100, 100CC, 1000	Yes	Matches current Flood Zone Map (FZM). Depth and Velocity available, though velocity used with caution
Court Hey Brook	341805, 390321	342027, 389843	575	2009	HEC-RAS	20, 100, 100CC, 1000	No	Doesn't match current FZM. No depth or Velocity data available.
Ditton Brook	345567, 386662	349587, 383907	5,159	2008	ISIS, JFLOW	100, 100CC, 200, 1000	No	Doesn't match current FZM. Depth grid not available for areas within Knowsley.
Logwood Mill Brook	345724, 393695	346209, 388085	6,990	2012	ISIS-TUFLOW	10, 25, 75, 100 , 100CC , 200, 1000	Yes	Doesn't match current FZM. Depths and Velocities are available.
Netherley and Halewood	344695, 389652	346239, 385910	4,824	2012	ISIS-TUFLOW	10, 20 , 75, 100 , 100CC , 200, 1000	Yes	Matches current fluvial FZM outlines. Depths and Velocities are
	343619, 387070	345416, 387406	2,646					
	344831,	345549,	891					

Hydraulic Model Name	Upstream Grid Reference	Downstream Grid Reference	Modelled Length (m)	Date Modelled	Model Type	Return Periods Modelled	Used	Comment
	386334	386641						available.
River Alt	339762, 397729	329528, 403628	17,350	2011	ISIS-TUFLOW	2, 5, 10, 25, 50, 75, 100 , 100CC , 200, 1000	Yes	Doesn't precisely match current FZM. Model results files were provided.

- 2.2.24 It will be noted from table 2-3 that the model data for Court Hey Brook and Ditton Brook is not used in the SFRA and it has not therefore been used to assess in more detail the potential site allocations within Knowsley. These datasets were both generated in 2008/2009 and do not match the current Flood Zone Map, there are therefore serious doubts regarding the validity of the data presented. There is also no depth or velocity data associated with these models and the allocation sites that are affected by them are also covered by other models.
- 2.2.25 The Childwall Brook model data matches exactly the Environment Agency's Flood Zone Map, which reflects the lack of flood defences on this watercourse. There are properties shown to be at risk from this watercourse in a 1% AEP flood event that are located to the north of St. Paschal Baylon Boulevard and adjacent to the watercourse. In particular, properties on Glynne Grove and parts of Gladstone Avenue and Edenhurst Avenue are also shown to be at risk. Climate change is shown to increase the areas at risk in these locations, which affects a larger number of properties. The 0.1% AEP flood extent is not shown to be any larger than the 1% AEP event plus climate change. South of St. Paschal Baylon Boulevard, only a sports ground and fields are affected within Knowsley, however, outside of the Borough there are potentially significant impacts.
- 2.2.26 The detailed model results that are available for Logwood Brook / Prescott Brook indicate that there is no flooding in a 1% AEP event through Prescott and that despite isolated areas of flooding along the watercourse there are no properties impacted in this event. The effects of climate change are shown to marginally increase the number of isolated areas of flooding, however, there remain no impacts to property. The 0.1% AEP event results in some flooding near Stretton Way (National Grid Reference (NGR) 345980, 389768), around Ellis Ashton Street (NGR 345876, 390238) and either side of Carr Lane. It has no impact on

people or infrastructure, however, a number of properties along Whiston Lane and Brook House at NGR 345775, 391102 are inundated along with the road. There are also properties off Westbrook Avenue affected along with Dye House to the north affected in this event. It is noted that the outputs of the Logwood Mill Brook model does not match the latest EA Flood Zone Map.

- 2.2.27 The outputs of the Netherley Brook model indicate that an existing property in The Meadows to the south of Netherley is impacted from Netherley Brook in a 5% AEP (1 in 20yr) flood event. Elsewhere, to the north of Halewood there are numerous properties affected in a 5% AEP event from Woodend Brook (a tributary of Netherley Brook that runs alongside Cartbridge Lane), which affects areas to the north of St. Nicholas's Church and alongside Hever Drive. The results for the 1% AEP event shows a slightly greater extent of flooding at The Meadows. In Halewood the extent of flooding is marginally greater and affects additional properties off Applewood Grove and Cherrywood Avenue. Buildings at a boarding kennels are also affected. Climate change increases flood extents in this event marginally, though this has little impact anywhere except in Halewood where there are a few more properties impacted and at a pumping station. The 0.1% AEP flood event additionally affects a sewage treatment works north east of Netherley, and impacts a number of additional properties in Halewood.
- 2.2.28 The Netherley Brook model is a 1D-2D hydraulic model so detailed information about the depth, velocity and hazard of floodwaters is available and is mapped in Figures B3 – B1, C1 and D1 for the 1% AEP event. To the east of Halewood, flood waters back up behind the railway embankment in this event and reach depths of over 1m in places. The velocity of the floodwaters is low (less than 0.5m/s) but this still represents a significant hazard to people because of the significant depth of the flooding. The fluvial risk here will constrain development opportunities. Where flooding reaches the existing residential areas in Halewood the depth of flooding is less than 0.50m and the hazard is low to moderate.

2.3 Defences, Assets and Structures

Flood Defences

- 2.3.1 Formal flood defences within Knowsley Borough are limited to a 250m stretch along the left bank of Dog Clog Brook and a 790m stretch along the right bank of the Dog Clog Brook to the north of Tarbock Green. Additionally, there are defences along the right (1.79km) and left (0.86km) banks of Ditton Brook to the north west of the A562. There is a 260m long stretch along the left bank of Netherley Brook (i.e. within Liverpool District) and finally, there is 0.83m stretch of flood defence on the right bank of Croxteth Brook south of the A580. There are

no Areas Benefiting from Defences (ABD) within Knowsley, which implies that none of the defences provides protection against flooding with a 1% chance of occurring. An ABD does exist on Netherley Brook, however, this is within the adjacent Liverpool District.

- 2.3.2 Figure B2 presents the Environment Agency's Flood Zones and defences. The NFCDD data indicates that none of the man-made raised defences in the Borough are in a good condition. They are all in either a fair or very poor condition. The design standard of the defences varies between a 5 year Standard of Protection (SoP) and a 100 year Standard of Protection.
- 2.3.3 The defences with a high SoP (100 year) are in the south of the Borough, along Ditton Brook and Dog Clog Brook. The Ditton Brook defences consist of raised earth embankments which have been assessed as being in a very poor condition. As described above, the modelling results suggest that these defences do not actually provide a 100 year SoP. The flood bank at Dog Clog Brook is classified as being in a fair condition and is supposed to provide property protection up to the 1% AEP event. This watercourse has not been modelled.
- 2.3.4 The defences with a lower SoP (less than 100 years) include short reaches on the Netherley Brook and Spring Brook in the south of the Borough which are in a fair condition. The low SoP is confirmed by the modelling data which shows the defences are overtopped in the 1% AEP. In the north of the Borough the embankment along Croxteth Brook is considered to be in a fair condition and had a SoP of 25-50 years.
- 2.3.5 Within the south of the Borough, the Netherley and Halewood Brook hydraulic model includes both defended and undefended model runs, however, the defences are on the right bank of the watercourse and therefore protect properties within Liverpool District and not Knowsley. The model results have been reviewed and the defences appear to provide a level of protection equivalent to between a 0.5% AEP and a 0.1% AEP flood event. From the 1% AEP event and above, there are small areas within Knowsley that appear to receive disbenefit from the presence of these defences, however, they are rural and there is no increase in risk to property.
- 2.3.6 The results of the River Alt Strategy Model show only a small floodplain in the 1% AEP within the boundary of KMBC on the Kirkby golf course in the north west of the Borough. There are no defences here and the extent of the 1% AEP floodplain is the same in the defended and undefended scenarios.

Culverted Watercourses

- 2.3.7 A review of the Environment agency's National Flood and Coastal Defence

Database (NFCDD) indicates that within the Borough there are 51 culverts, i.e. the Asset Type attribute within the NFCDD is identified as a culverted watercourses, that are considered to be ‘major’ defences and which it is considered will have an important flood risk management function. There are also additional structures, omitted from the culverted watercourse classification which would fall within the category of culverted watercourse.

- 2.3.8 The full list of culverts, the watercourses within which they are located, the asset references, grid reference, body responsible for maintenance and their condition and design standard are provided in Appendix B. A summary of those that exist is provided below.
- 2.3.9 There are culverted sections along the River Alt within its headwaters in Huyton and along its route, particularly bordering Stockbridge Village. A number of its tributaries are also culverted to the point that there is little or no visible sign of their existence above ground. Many have been partly incorporated into the sewer system. There are also a number of culverted sections of Knowsley Brook, through Knowsley Business Park, as well as within Kirkby Brook where it passes through Northwood from Knowsley Industrial Park.
- 2.3.10 Mastermap data and hydraulic modelling confirms the presence of a 3.2km length of culverted watercourse within Childwall Brook, in the upper reaches of Netherley Brook. Netherley Brook is also culverted for approximately 650m in its upper reaches.
- 2.3.11 A review of the culverts and the land use and flood risk in the vicinity has been undertaken and the table below presents those culverts where it may be possible to ‘daylight’ or remove and open up the culvert. Further analysis to assess the feasibility of ‘daylighting’ these culverts would be required in consultation with land owners, the Environment Agency and the public before any work is undertaken.

Table 2-4: Culverts within the Knowsley Borough with the potential for ‘daylighting’

Watercourse	NFCDD Asset Reference	Grid Reference	Maintainer	Opportunities for ‘daylighting’
Knowsley Brook	01214KNOW0101B11	SJ4273996652	Private	Perhaps, if redeveloped
	01214KNOW0101B12	SJ4287496671	Private	Perhaps, if redeveloped
	01214KNOW0101B13	SJ4287296785	Private	Perhaps, if redeveloped
	01214KNOW0101B14	SJ4306696805	Private	Perhaps, if redeveloped
	01214KNOW0101B15	SJ4327596818	Private	Perhaps, if redeveloped
	01214KNOW0101B16	SJ4346196828	Private	Perhaps, if redeveloped
	01214KNOW0101B18	SJ4363396991	Private	Yes
	01214KNOW0101B19	SJ4363396991	Private	Yes

Watercourse	NFCDD Asset Reference	Grid Reference	Maintainer	Opportunities for 'daylighting'
Ormskirk Road	01214ORMS0201B02	SJ4408395317	Local Authority	Not recommended
Brunt Boggart	01315BRNT0101B01	SJ4658387972	Private	Yes but would affect field
	01315BRNT0101B06	SJ4678188229	Private	Yes but would affect field
Childwall Brook	01315CHIL0101B01	SJ4465488339	Private	Potentially within Sports Ground and alongside Sarum Road depending upon culvert alignment relative to road
Dog Clog Brook	01315DOG10101B20	SJ4961488722	Private	Yes
	01315DOG20101B01	SJ4735687777	Environment Agency	Yes
	01315DOG30101B01	SJ4716087764	Environment Agency	Yes
	01315DOG30101B02	SJ4716787769	Environment Agency	Yes
	01315DOG30101B03	SJ4720687838	Private	Yes
	01315DOG40101B01	SJ4717087770	Environment Agency	Yes
	01315DOG40101B02	SJ4735787778	Private	Yes
Fox's Bank Brook	01315FOX0101B06	SJ4705189154	Private	Yes
	01315FOX0101B09	SJ4706689176	Private	Yes
Halewood Brook	01315HAL10101B10	SJ4510587229	Private	Yes but would affect field
Huyton Brook	01315HUY10101B05	SJ4357989713	Private	Northern half, not below M62
Netherley Brook	01315NETH0101B12	SJ4466189632	Private	Not recommended
Prescot Brook	01315PRES0101B01	SJ4591392672	Private	Potentially but would affect playing field
	01315SPRG0101B07	SJ4712686101	Private	Potentially south eastern half
Stonehough Brook	01315STOB0101B06	SJ4639687502	Local Authority	Potentially the eastern half of the culvert
	01315STOB0101B11	SJ4632987509	Private	Potentially the eastern end of the culvert
Woodend Brook	01315WEND0101B03	SJ4528286557	Private	Potentially
	01315WEND0101B08	SJ4491886395	Private	Potentially in parts

2.3.12 In addition to culverted watercourses identified within the NFCDD, United Utilities asset data is a valuable source of information on sections of watercourse that may be piped, which typically United Utilities consider to be private, i.e. not maintained by them.

2.3.13 Approximately 475m of Prescot Brook/Logwood Mill is identified as private

sewers within the United Utilities asset data where it borders Prescott. United Utilities data suggests that this starts off as a 1200mm diameter culvert, changes to a 225mm diameter pipe and then increases again to a 1050mm diameter culvert. Environment Agency model data suggests that it is a 1250mm diameter culvert for its entire length. Private sewer sections also meet the downstream end of this culvert that drain areas of Prescott from the east.

- 2.3.14 A series of private sections of sewer are interconnected with sections of public sewer flowing south westwards through the north of Whiston to meet up with Prescott/Logwood Mill Brook to the west of the M57. This could effectively be described as a hidden watercourse and appears to have been entirely incorporated into the sewer system.

2.4 Groundwater Flooding

- 2.4.1 The KMBC Preliminary Flood Risk Appraisal (PFRA) Preliminary Assessment Report (PAR) indicates that the available information on groundwater flood risk, the Areas Susceptible to Groundwater Flooding (AStGWF) dataset, is coarse in scale and difficult to use when identifying areas potentially at flood risk. The PFRA also indicates that a more detailed study into groundwater resources within the Mersey and North Merseyside concluded that whilst groundwater levels may rise locally, predominantly as a result of the cessation of mining, levels would not rise significantly.
- 2.4.2 The Level 1 SFRA presents in Appendix E DEFRA's Groundwater Emergence Map (GEM), which identifies areas where, in exceptionally wet winters, groundwater may be expected to rise to be close to or at the ground surface. It also indicates that the lower lying areas of the Alt floodplain extending into Kirkby Brook, Knowsley Brook and Croxteth Brook are at risk, as well as areas of the River Alt within Stockbridge Village extending southwards towards Huyton. There are also large areas shown to be potentially at risk in the upper reaches of Netherley Brook within Bowring Park, a small area within the floodplain of Fox's Bank Brook and extensively along Netherley Brook and Ditton Brook from Netherley to Ditton.
- 2.4.3 There is little overlap between the GEM and the AStGWF datasets. The GEM dataset appears to reflect the findings of the Mersey and North Merseyside Water Resources study more closely, which gives some confidence with respect to its use to assess the source of groundwater flooding.
- 2.4.4 As a result of the above and despite the absence of information that confirms groundwater flooding to have been a cause of historical flooding or to be a significant risk, groundwater flooding is considered to be a potential source of

flooding in some locations within Knowsley.

2.5 Surface Water and Sewer Flooding

Flood Map for Surface Water

- 2.5.1 The Knowsley PFRA considered both the Environment Agency's Flood Map for Surface Water (FMfSW) and Areas Susceptible to Surface Water Flooding (AStSWF) datasets to determine which data should be used as 'Locally Agreed Surface Water Data' for the Knowsley area. Both data sets were compared to known locally agreed surface water data including the effects of an estimated 1 in 100yr rainfall event that occurred on 20 July 2010 and it was agreed that the FMfSW was more representative of the flood risk. It was therefore decided that the FMfSW would be adopted for use within the PFRA as the "locally agreed surface water information" and for consistency this dataset is the preferred source of information on surface water flood risk within this SFRA.
- 2.5.2 The FMfSW shows areas where surface water would be expected to flow or pond. Two rainfall events, 1 in 30 and 1 in 200 year were modelled and mapped. For each rainfall probability, two outputs were provided,
- flooding greater than 0.1m deep
 - flooding greater than 0.3m deep
- 2.5.3 The 0.3m threshold was chosen as it represents a typical value for the onset of significant property damages when property flooding may start (above doorstep level) and because it is at around this depth that moving through floodwater (driving or walking) may become more difficult. Both of these may lead users to consider the need to close roads or evacuate areas.
- 2.5.4 The FMfSW dataset for the 1 in 200 year rainfall event has been used to present in Figure B5 the risk of surface water flooding within the study area. It should be noted that the data set should not be used to predict if individual properties will flood and does not show if they have been affected by surface water flooding in the past.
- 2.5.5 Figure B5 shows pockets of surface water flooding across the study area, particularly across Knowsley Industrial Estate, Kirkby, Stockbridge Village, and Huyton. Key infrastructure shown to be affected includes the M62, M57 and Ainsworth Lane / Overbrook Lane through Knowsley Business Park. In the western and south part of the Borough, where the land use is much more rural in character, surface water flooding is shown to largely be conveyed by the natural river channels and as such it presents fewer consequences.

- 2.5.6 Despite this extensive surface water flood risk, there are few areas where there is a flood risk to a large number of properties, the exceptions being in Knowsley Business Park and perhaps Knowsley Industrial Park. There is evidence that surface water flood risk is influenced in places by the presence of infrastructure, particularly along the M57 corridor where there are shown to be areas of ponding along and adjacent to the motorway. This also occurs in places along the A57 within Huyton and the A580 south of Kirkby.
- 2.5.7 There is also evidence of historical flow paths that are no longer present within available databases of existing watercourses and which may now have been incorporated by the sewer system. These are particularly clear in Kirkby to the north and south of Southdene, in Prescott to the north of Whiston and Whiston Cross, and in Cronton.

Historic Records

- 2.5.8 Knowsley Metropolitan Borough Council maintains a database of reported flooding incidents within the Borough. Records held in this database represent records from 1999 to the present day. In total there are over 1500 records containing information on a wide variety of consequences, such as, flooding of carriageways. KMBC can be consulted for further information on its historical flooding records database.

Sewer Flooding

- 2.5.9 United Utilities has provided data of its sewer assets as well as its records of incidents within its sewer system. The urban areas of Knowsley are well served by United Utilities sewers with only the small settlements between Huyton, Halewood, Ditton and Cronton being off network.
- 2.5.10 There are a number of sources of data with respect to sewer flooding. United Utilities maintain an incident reporting system of flooding events associated with its assets. Prior to April 2008 this was referred to as the Sewer Incident Recording System (SIRS), though following changes to the data that was recorded this became the Water Incident Recording System (WIRS). Records are kept of the location of flooding and the causes and effects, including whether there is internal or external flooding, basement flooding etc.
- 2.5.11 A review of the WIRS data indicates that there are 76 records of surface water flooding within the WIRS datasets between 1st April 2008 and 3rd May 2012. The causes of these incidents include blockage, collapse and hydraulic inadequacy. Additional influences include exceptionally severe weather, siltation and tree roots. Of these 76 records, 7 records were of property flooding, 6 were of cellar flooding, 7 were of adjoining property flooding, 29 were of garden flooding, 25

were of highway flooding and 2 were of flooding of public open space.

2.5.12 United Utilities also maintains a register of properties that are known to be at risk from sewer flooding, known as the DG5 Register. The DG5 register contains properties that are at risk based on previous internal or external flooding from various causes, though most often hydraulic inadequacy, and which occurs in events more frequently than one every 20 years. It does not contain properties that have not yet flooded, i.e. it is not a predictive database of properties that might flood. The DG5 register for Knowsley has been provided by United Utilities and it indicates the following:

- A property within Knowsley Village at risk of flooding with a frequency of 2 in 10 years;
- Various properties across Huyton at risk from flooding with frequencies ranging between 2 in 10 and 1 in 20 years;
- Various properties across Prescott at risk from flooding with frequencies ranging between 2 in 10 and 1 in 20 years; and
- Isolated properties within Halewood at risk from flooding with a frequency of 1 in 20 years.

2.5.13 Figure B6 presents mapped records of sewer flooding within the study area based on United Utilities' WIRS dataset.

2.5.14 United Utilities has also provided outputs from its sewer models within the study area. These outputs provide information on the location and volume or predicted surcharging across United Utilities models within the Borough. The volume shown to flood from a manhole represents the largest predicted surcharging volume from a range of storm durations. This makes direct comparison impossible, however, analysis of these results can indicate the current potential for sewer flooding within the study area for a 3.3% AEP (1 in 30 year) storm event.

2.5.15 The sewer modelling results show predicted surcharging of sewer manholes across all serviced areas of Knowsley. With respect to certain events, flooding is simulated to occur as frequently as once in 1 year in isolated manholes in Kirkby, Prescott and Halewood, though more densely in Huyton. Large flooding volumes in this event are shown in the Whitefield Lane End area of Huyton and to the east of Halewood. This pattern continues for the once in 10 year and once in 20 year events. The flooding volumes increase and in addition to the above, large volumes are also simulated to surcharge in rural areas to the south west of Cronton, north of Huyton Quarry and to the south west of Whiston Cross. Events above the once in 30 year event reinforce this pattern.

2.5.16 In general, the modelling indicates a sewer system that in places would not provide the design capacity associated with a new build system, which is an understandable issue affecting older sewerage systems. As events become more extreme the number and density of manhole surcharging across urban areas increases. This is likely to lead to localised and in some cases severe consequences, however, the largest surcharging volumes are generally on the downstream side of urban areas and in rural areas. It is anticipated that climate change, which is currently predicted to result in wetter winters and to increase storm intensity, will increase the extent of these areas and perhaps result in a risk of flooding in areas that are not currently shown to be at risk. Further development also has the potential to increase pressure on the system unless surface water is effectively managed to result in no detriment and if possible to provide betterment.

2.6 Flooding from Artificial Sources

Canal

2.6.1 The Leeds and Liverpool Canal flows through the Borough for approximately 10m, west of Kirkby (NGR 339190 398710), the canal is not raised at this point and it is located within farmland / golf course. It is raised approximately 300m east of the Borough boundary to allow the River Alt to flow beneath it. Although there remains a residual risk of canal failure it is concluded that the probability and the resulting risk would be low within Knowsley, particularly as the topographical gradient would channel flow away from the Borough along the route of the River Alt.

Reservoirs

2.6.2 There are relatively few reservoirs within the Borough of Knowsley, however, areas in the south of Borough are affected by flooding from reservoirs located outside of the Borough.

2.6.3 The Environment Agency is the enforcement authority for the Reservoir Act 1975¹⁷ in England and Wales. The Environment Agency ensures that reservoirs are regularly inspected and essential safety work is carried out. KMBC is responsible for co-ordinating emergency plans for reservoir flooding and ensuring that communities are well prepared. Figures B1-1 and B1-2 in Volume 2 show the reservoirs within the Borough of Knowsley.

2.6.4 The Reservoirs Act 1975 is in the process of being updated by the Flood and Water Management Act 2010. The Flood and Water Management Act reflects a

¹⁷ Reservoirs Act, 1975.

more risk-based approach to reservoir regulation through:

- Reducing Capacity at which a reservoir will be regulated from 25,000m³ to 10,000m³;
- Ensuring that only those reservoirs assessed as high risk are subject to regulation;
- Ensuring that all undertakers with reservoirs over 10,000m³ register their reservoirs with the Environment Agency;
- Inspecting engineers must provide a report on their inspection within 6 months;
- All undertakers must prepare a reservoir flood plan; and
- All incidents at reservoirs must be reported.

2.6.5 Reservoir owners will in due course be required to prepare on-site emergency plans. On-site emergency plans detail how reservoir owners or those responsible for the operation of a reservoir will respond to a potential or real reservoir failure. It is good practice for all reservoirs to have on-site plans and all reservoir owners are recommended to prepare one.

2.6.6 In 2009 the Environment Agency produced a series of reservoir inundation flood maps. Only large reservoirs that hold over 25,000 cubic meters of water were assessed. Maps of the maximum flood extent are available on the Environment Agency's website and have been provided by the Environment Agency for use within this SFRA to determine the potential risk to key development sites.

2.6.7 White Man's Dam is located within Knowsley Park and is owned and maintained by the Earl of Derby's Estate (NGR 344965 394135). It is shown to flood areas between the reservoir and Stockbridge Village. The flood waters are conveyed north by Croxteth Brook towards the River Alt and therefore flooding could affect a number of properties along this path.

2.6.8 Mizzy Dam, is also located within Knowsley Park and is owned and maintained by the Earl of Derby's Estate (NGR 345727, 393683). It is shown to flood areas to the south and south west reaching the M57 around Junction 2 and extending along the path of Prescott Brook until it too reaches the M57 where the floodwater would largely be held back.

2.6.9 Pex Hill No. 2 and Pex Hill No. 3 are owned and maintained by United Utilities Water plc and is located at NGR 350210 388990, just within the Knowsley boundary at Pex Hill. The reservoirs are covered reservoirs that are used as storage reservoirs fed from boreholes in the red sandstone. The path for floodwater from a reservoir failure at Pex Hill No. 3 would head south eastwards

into the adjacent Halton Borough, where it could impact properties in Norland's Farm, isolated properties on Wilmere Lane, at Cranshaw Hall and adjacent to Bower's Brook to the east of Farnworth, A small spur of flood water could head back south westwards along the boundary of Knowsley affecting the Riverside College, properties on the edge of Upton Rocks and properties to the south of Cronton on Chapel Lane. Additionally, flooding from both Pex Hill No. 2 and No. 3 could flow south westwards through Cronton and along the path of watercourses that eventually meet Dog Clog Brook. The extent of flooding is not shown to reach beyond the A5300.

- 2.6.10 Prescott No.3 and No.4 reservoirs adjoin the boundary of Knowsley at NGR 346920 393950, north of Prescott. Although located outside of the Borough, should a breach in either of the reservoirs occur, communities within Knowsley are likely to be at risk. Flood waters are conveyed south westwards to impact areas within Prescott and Huyton. Again, flows are also conveyed north westwards, though they may take the path of the River Alt or the path of the Croxteth Brook. Prescott No 3 and No.4 reservoirs are owned and maintained by United Utilities Water plc.
- 2.6.11 The probability of reservoir failure is low and there hasn't been a loss of life in the UK since 1925. This was as a result of the overtopping of Skelmorlie Reservoir and the failure due to poor construction of a cascade at Dolgarrog in North Wales. Although the probability of failure is very low, the consequences of a failure are potentially high, and this is clearly shown by the extent of potential reservoir inundation presented in Figure B7.
- 2.6.12 The active management and regular maintenance of these structures mean that there is a low to very low probability of failure, however, the extent of areas shown to be potentially at risk is large and the consequences of flooding if it were to occur are likely to be very high. This assessment therefore concludes that there is a medium risk of flooding from this source. This correlates with the risk rating presented within the Merseyside Community Risk Register, published by the Merseyside Resilience Forum.
- 2.6.13 In light of this, the risk of reservoir flooding should be considered to be a residual risk to new development. This should be acknowledged when assessing the risks to a site and which should, if possible be included in measures proposed to manage flood risk. As a residual risk, however, it should not be used to determine whether development should take place on a site or not.
- 2.6.14 As discussed in Section 7 this document is a living document and therefore KMBC should update this section of the SFRA to reflect future updates to guidance within the Reservoir Act. This is anticipated to be updated in October

2012.

2.7 Summary of Flood Risk

- 2.7.1 Analysis of the available information collated for the study area shows that there are a number of sources of flood risk that should be considered at all stages of the planning process.
- 2.7.2 In general, information on historical fluvial flooding is limited, which, combined with the extent of flooding shown in Environment Agency Flood Zone Maps, indicates that fluvial flooding is not a widespread or significant constraint to development. There will inevitably be impacts to some proposed development however. Flood Zone 3b is likely to be restricted to the channel in most locations but there may be areas where it exceeds the channels capacity and enters the floodplain, Flood Zone 3a is generally restricted to rural areas or to undeveloped floodplain within the urban area. Flood Zone 2 is more extensive but not significantly so and again is generally limited to rural areas and the undeveloped floodplain within urban areas.
- 2.7.3 There are some Environment Agency flood defences in Knowsley but Environment Agency mapping shows no Areas Benefiting from Defences in the 1% AEP event. The defences typically have a Standard of Protection less than 100 years and are mostly in a fair to very poor condition.
- 2.7.4 The results of more detailed hydraulic modelling provided by the Environment Agency confirms that fluvial flood risk will not be a significant constraint to development in Knowsley. Where there is a fluvial floodplain, it is mostly in rural areas and undeveloped floodplain. 2D results from the Netherley Brook model show that the predicted depth of flooding in the 1% AEP event is greater than 1m behind the railway embankment and represents a significant hazard to people.
- 2.7.5 Extensive surface water flooding records are available from KMBC's Confirm database plus those from United Utilities, showing that surface water flood risk is one of the key issues within the Borough. Mapping shows extensive areas at risk across the Borough, though there are few individual areas of widespread flooding affecting a lot of properties and the areas at risk therefore seem to be restricted to local flow paths and isolated areas of ponding. There is also evidence of historical watercourses that appear to have been incorporated into the sewer network and no longer exist. These may be a source of flooding in a few locations. Climate change and further development is likely to increase the risk and potentially the consequences of flooding from this source.
- 2.7.6 Sewer modelling shows the potential for widespread flooding from the sewer

network, including in events with a frequency as often as once every year. All urban areas are considered to be at risk though the larger flood volumes are generally seen outside of urban areas. Climate change and further development is likely to increase the risk and potentially the consequences of flooding from this source.

- 2.7.7 Groundwater risk is present in areas at risk from fluvial flooding sources, though it is typically not more extensive than Flood Zone 2. The contribution that groundwater plays in surface water and fluvial flooding should certainly be taken on board when planning new development and assessing the risks to development.
- 2.7.8 The risk from canal infrastructure is considered to be negligible; however, there are residual risks from reservoirs within the Borough, particularly in Huyton and parts of Prescott and along the Croxteth Brook and River Alt floodplains.

3 How to use the SFRA in Forward Planning

3.1 Introduction

3.1.1 Guidance on development and flood risk is presented in the recently published National Planning Policy Framework (NPPF) and a supporting Technical Guidance to the NPPF (March, 2012).

3.1.2 The NPPF requires that the allocation of sites take account of the nature and spatial distribution of flood risk as well as the degree of vulnerability of different types of development. This should be achieved at all stages of the development planning process, including the allocation of sites in the Local Plan and when assessing windfall planning applications. The NPPF advocates a sequential, risk-based approach to the allocation of sites and to development within sites.

3.1.3 The evidence presented in this SFRA is intended to inform the Local Plan and to provide an appropriate level of detail so it can be considered robust with respect to flood risk. The SFRA should be used by KMBC to assess allocations for new development sites and to apply the risk-based Sequential Test and, where necessary, the Exception Test by referring to technical information and flood maps. The SFRA provides the necessary information for planners to make strategic decisions that identify the amount and type of development that may be appropriate, requirements for the management of runoff, and identification of strategic responses (options) to manage flood risk. Developments will still require a detailed flood risk assessment where they lie within Flood Zones 2 or 3 or where the site lies within Flood Zone 1 and is greater than 1ha in area.

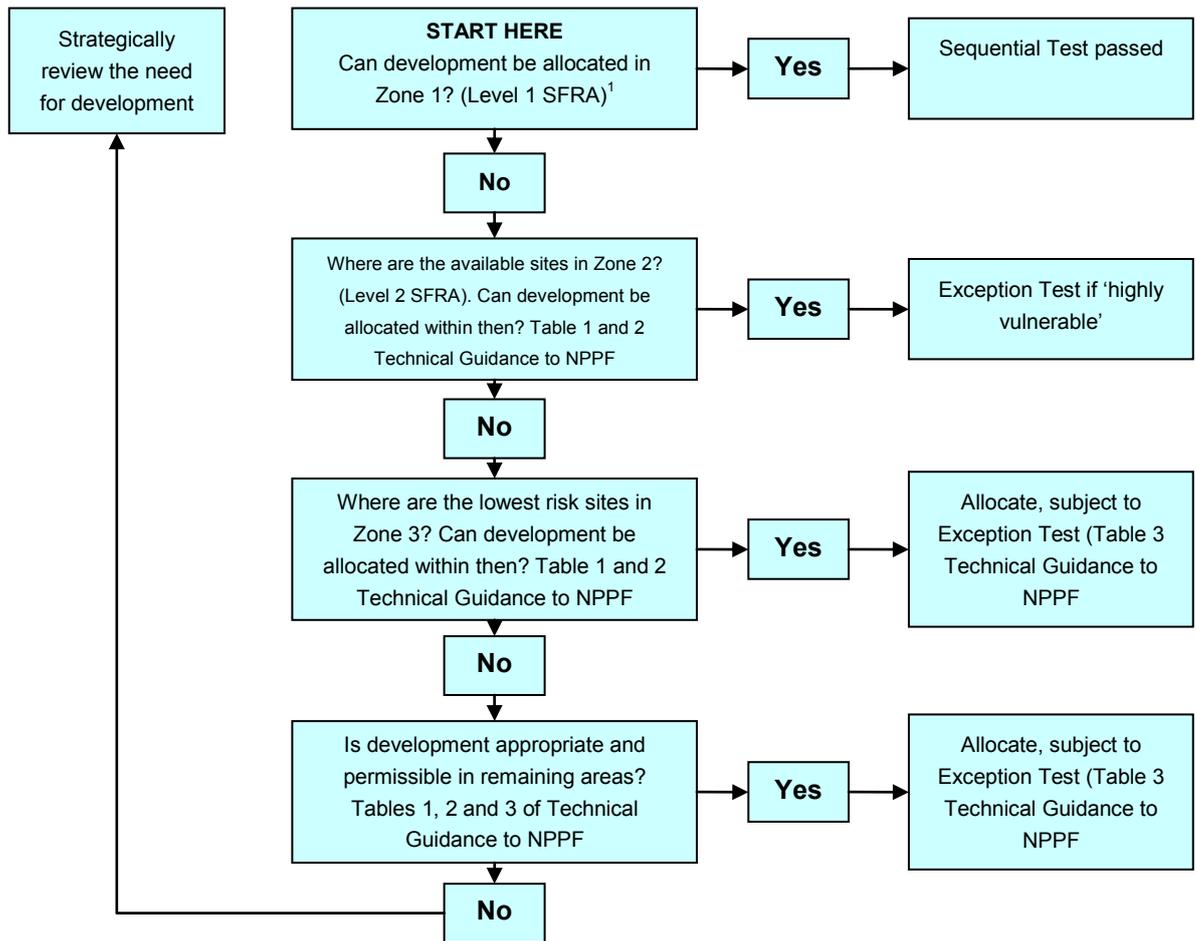
3.1.4 In summary, the results of the SFRA can be used to:

- Apply the risk-based sequential approach, including assessing site allocations within flood zones, and where necessary the Exception Test;
- Support appropriate policies for the management of flood risk within Knowsley;
- Inform the Sustainability Appraisal so that flood risk is taken into account when considering options and the preparation of strategic land use policies; and
- Set planning constraints within designated development areas and where relevant in the case of windfall planning applications.

3.2 Sequential Test

- 3.2.1 The risk-based Sequential Test should be applied at all stages of planning. The Flood Zones are the starting point for the sequential approach (NPPF, Section 100), the aim of which aim is to steer new developments to areas with the lowest probability of flooding (Zone 1).
- 3.2.2 The SFRA builds on the Flood Zones and presents more refined information on flood risk by taking into account the presence of flood defences and other flood risk management infrastructure, by presenting information on depth, velocity and hazard (where available) and by presenting information on other sources of flooding and climate change (Technical Guidance to the NPPF, Section 4). Where an SFRA is available that contains this information then this should be the basis of applying the Sequential Test against the flood zones presented in Table 1 of the NPPF (NPPF, Section 102), which is recreated in Table 2-2.
- 3.2.3 It is recognised that flood risk information must be considered alongside other spatial planning issues. Allocations are thus “Tested” on the basis of their flood risk attributes and the outcome used to inform decisions that include other spatial planning issues. To perform the “Test” KMBC first needs to be aware of what sites are reasonably available¹⁸ within the Borough. It is necessary to clearly define “reasonably available” and be able to provide evidence that there are not locations outside of those considered with a lower probability of flooding that could be considered to be “reasonably available”.
- 3.2.4 Evidence of the application of the Sequential Test should be provided through the Sustainability Appraisal process. When applying the Test it will be important for KMBC to demonstrate that a transparent process has been formulated and followed; that this process has sought to steer new development to areas with the lowest probability of flooding; and that full consideration has been given to reasonably available alternatives on land with a lower probability of flooding.
- 3.2.5 Figure 3-1 contains a flow chart for use by KMBC in the application of the Sequential Test. It is a tool to help the decision-maker locate a proposed development in lower flood risk categories. Table 3.1 contains additional notes which direct the user to the particular chapters of technical information or mapping within this SFRA and which should be used in each stage of the process.

¹⁸ Reasonably available is considered to mean those sites that can meet the functional requirements of the type of development proposed, are located in an appropriate location, could be available for the developer to use for the proposed purpose, and which can be reasonably developed for that purpose.



Note 1. Other sources of flooding need to be considered in Flood Zone 1

Note 2. Adapted from the PP25 25 Practice Guide (June 2008) to be applicable to the NPPF.

Figure 3-1: Application of the Sequential Test

3.2.6 The flood risk information required to address the four stages in the application of the Sequential Test noted above is provided in the flood maps in Volume 2 of this SFRA. Specific guidance for KMBC on the use of these flood maps in the application of the Sequential Test is provided below in Table 3-1.

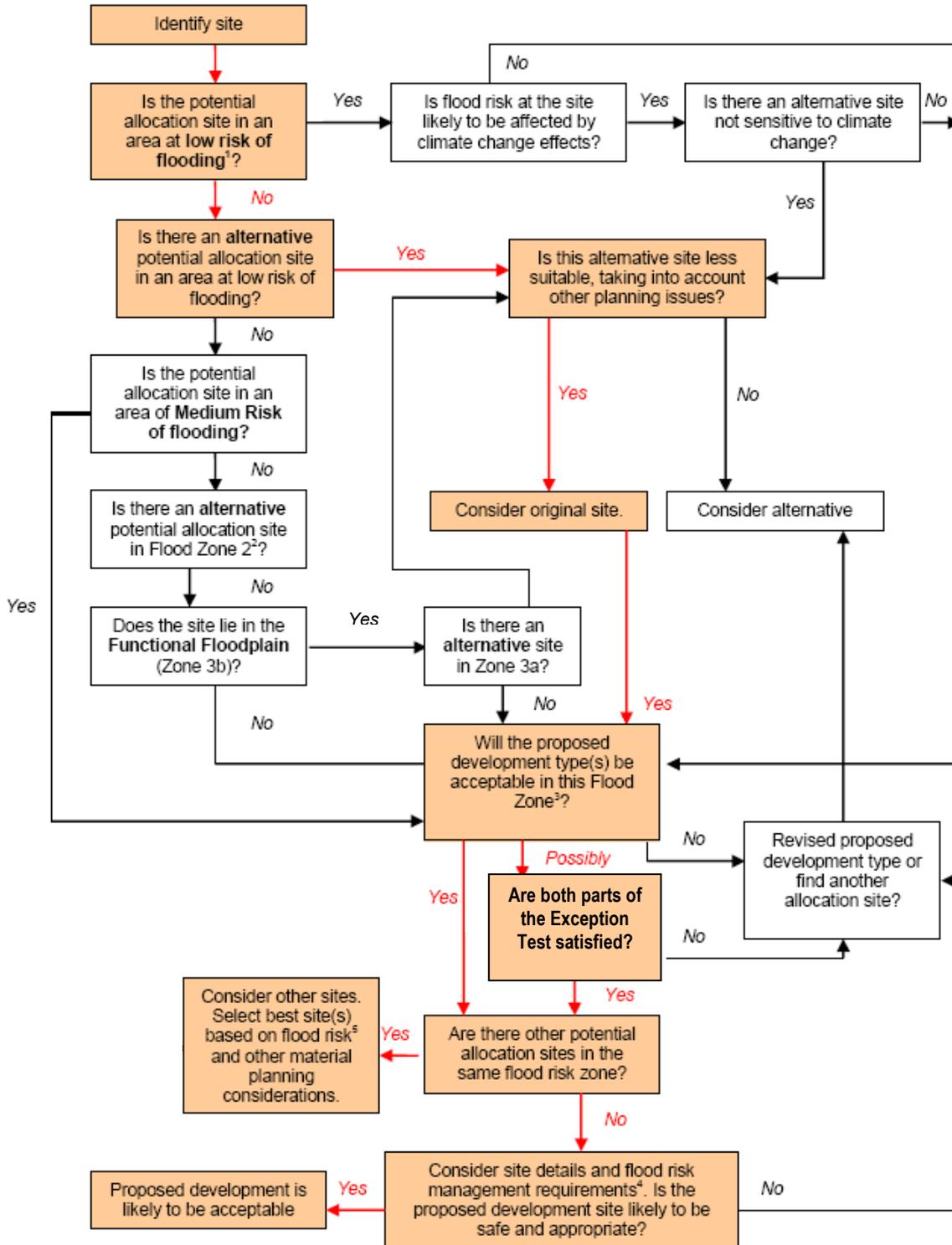
Table 3-1: How to Apply the Sequential Test

Stage in Sequential Test	Guidance	Associated figure in SFRA (Volume 2)
1. Can development be allocated in Zone 1?	<p>KMBC should use Flood Zone maps to identify areas of the Borough within Zone 1 and consider whether proposed developments can be allocated in Zone 1 areas.</p> <p>Within Zone 1, areas at risk from other sources of flooding should be avoided where possible.</p>	Figure B.2 – EA flood zones

Stage in Sequential Test	Guidance	Associated figure in SFRA (Volume 2)
<p>2. Where are the available sites in Zone 2? Can development be allocated within them?</p>	<p>KMBC should initially use Flood Zone maps to identify areas of Borough within Zone 2 and consider whether proposed developments can be allocated in these areas.</p> <p>If shown to be within Flood Zone 2, KMBC should use more detailed information within this SFRA to understand the extent and distribution of risk within Flood Zone 2.</p> <p>Within Zone 2, areas at risk from other sources of flooding should be avoided where possible.</p>	<p>Figure B.2 – EA flood zones</p>
<p>3. Where are the lowest risk available sites in Zone 3? Can development be allocated within them?</p>	<p>KMBC should use more detailed information within this SFRA to understand the extent and distribution of risk within Flood Zone 3.</p> <p>The Flood Zones do not take account of existing control structures and defences. Maps are presented in this SFRA which show the actual risk of fluvial flooding from watercourses when existing defences are in place.</p> <p>Within Zone 3, areas at risk from other sources of flooding should be avoided where possible.</p>	<p>Figure B3a – Modelled extent (actual risk) of fluvial flooding</p> <p>Figure B3b – Depth (1%)</p> <p>Figure B3c – Velocity (1%)</p> <p>Figure B3d – Hazard (1%)</p> <p>Figure B5 – Flood Map for Surface Water</p>
<p>4. Is development appropriate and permissible in remaining areas?</p>	<p>In considering the appropriateness of development in remaining areas, KMBC should consider the vulnerability of the proposed development and Tables 2 and 3 of the Technical Guidance to the NPPF.</p> <p>Information on the flood hazard on a fluvial flooding event is provided in maps in this SFRA.</p>	<p>Figure B3d – Hazard rating for fluvial 1% flood event</p>

3.2.7 It should be noted when applying the process outlined above that the Environment Agency’s Flood Map does not take into account small watercourses with a catchment area of less than 3km². As such the Flood Zone Map will not provide flood extents for many Ordinary Watercourses, that is rivers, streams, ditches, drains, cuts, sluices, sewers (other than public sewers) and passages through which water flows that do not form part of a main river. Furthermore, the detailed hydraulic models available for watercourses within the Borough also exclude most of the Ordinary Watercourses within the study area.

- 3.2.8 A review of the Flood Zone Map against the location of Ordinary Watercourses indicates that none of the Ordinary Watercourses have an associated Flood Zone. This may imply that there is no flood risk associated with the watercourse but it may also reflect the small size of the watercourse and lack of information. The Flood Map for Surface Water (FMfSW) 200yr map presented in Figure B5 can be a useful source of information to understand the potential flood risk associated with an Ordinary Watercourse. It is however recommended that where new development is proposed near to Ordinary Watercourses that a Flood Risk Assessment be undertaken to assess and if necessary manage the risk to and from these watercourses.
- 3.2.9 It should be noted that the process illustrated in Table 3-1 does not specifically take into account the potential impacts of climate change on the level of flood risk. It is recommended that KMBC consider the potential impacts of climate change when applying the third and fourth stages of the Sequential Test process described above. The potential impacts of climate change on fluvial flood risk is discussed in Section 2.2 of this report and presented in Figure B.3 in Volume 2 and this information should be referred to when considering where the areas of lowest risk within Flood Zone 3 are located.
- 3.2.10 The effects of climate change on other sources of flood risk within Knowsley is less well understood and it should therefore be the responsibility of the developer to show that the effects of climate change can be managed over the lifetime of the development.
- 3.2.11 The protocols adopted for the Sequential Test should be agreed with the Environment Agency. It is important that decision makers engage key stakeholders early in the decision making process. It is also important to consider uncertainty of information when making land use planning decisions.
- 3.2.12 Flood risk information should be considered alongside other spatial planning issues such as transport, housing, economic growth, natural resources, regeneration, biodiversity, the historic environment and other hazards. This other information is relevant with respect to defining whether alternative locations are “reasonable” and sustainable.
- 3.2.13 The template used within Volume 2 of this SFRA to assess the key allocation sites can be used by KMBC as a template when undertaking the Sequential Test. The site assessment proforma can be used to record the information used in the decision making process for each allocated area/site following the methodology outlined in Table 3-1, and in Figure 3-2.



¹ Flood Zone 1 for fluvial and tidal flooding and with a low risk of flooding from other sources.
² Flood Zone 2 for fluvial and tidal flooding and with a medium risk of flooding from other sources.
³ As defined by the Sequential Test.
⁴ Development to be safe and to not increase flood risk elsewhere. Required to pass the exception test, where applicable,
⁵ including susceptibility to future climate change and residual flood risk.

Figure 3-2: An example case study of allocating a site using the Sequential Test

3.3 Exception Test

3.3.1 The Exception Test can be applied, when appropriate and following the application of the Sequential Test, where it is not possible to locate development within flood zones that have a lower probability of flooding (NPPF, Section 102).

3.3.2 Figure 3-1 highlights the stages in the Sequential Test at which the Exception Test may need to be applied. The Test provides a method of managing flood risk whilst still allowing necessary development to occur. It may not always be appropriate to apply the Exception Test, however if applied, both of the following elements must be passed (explained in more detail in Sections 3.3.4 to 3.3.9):

- it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared; and
- a site-specific FRA must demonstrate that the development will be safe taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

3.3.3 Figure 3-3 presents the process that should be followed by KMBC in its application of the Exception Test under the NPPF.

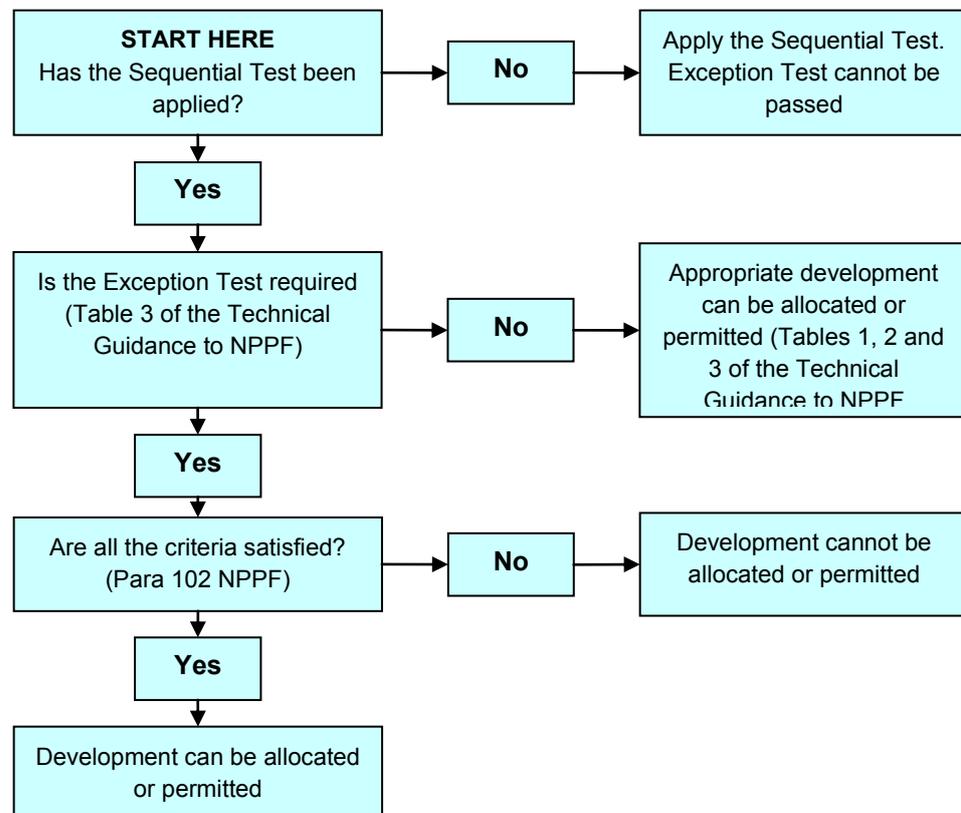


Figure 3-3: Application of the Exception Test

- 3.3.4 The first part of the test reflects on the wider sustainability benefits of the development, which should be tested against the aims and objectives of the Sustainability Appraisal and other Local Plan policy. As indicated above, other spatial planning issues such as transport, housing, economic growth, natural resources, regeneration, biodiversity, the historic environment and other hazards can influence the overall suitability and sustainability of development at a site and these issues should be considered in relation to whether the site meets the first criteria of the Exception Test.
- 3.3.5 The second part of the Exception Test relates to the safety of the development and the need to not increase flood risk elsewhere. There are no fixed criteria for what constitutes ‘safe’ development, as it will depend upon not only the nature of the development but also the source and mechanism of flood risk. Appropriate application of the flood risk management hierarchy of ‘Avoid – Substitute – Control – Mitigate’ can increase the safety of a development, however, it is the responsibility of the developer to show that the measures proposed are sufficient. Table 3-2, outlines the data that should be used when considering the above aspects and when determining the safety of a development over its projected lifetime.
- 3.3.6 It is important that Knowsley Council retain a record of all its assumptions and decisions with regard to both the Sequential and Exception Tests, in order to demonstrate that they have performed the process appropriately.

Table 3-2: Information available within the SFRA for assessing whether a site is ‘safe’

Exception Test: Safe Development		
Source of flood risk	Guidance	Associated figure in SFRA (Volume 2)
Fluvial flooding	<p>Are there areas of the site with an Actual risk of flooding?</p> <p>What is the probability of flooding within the site?</p> <p>Avoid if possible, otherwise ensure the vulnerability of the development matches the probability of flooding of the flood zone in which the development would be appropriate.</p>	Figure B3a: Actual risk of fluvial flooding
	<p>What is the depth of flooding?</p> <p>Seek to ensure that the internal ground floor level is at least 600mm above the 1% AEP flood plus an allowance for climate change, particularly for More Vulnerable development</p>	Figure B3b: Depth (1% AEP)

Exception Test: Safe Development		
Source of flood risk	Guidance	Associated figure in SFRA (Volume 2)
	<p>within Flood Zone 3a.</p> <p>Ensure access and egress routes are dry where possible</p>	
	<p>What is the velocity of flooding?</p> <p>Where possible, seek to ensure that the velocity of flood water is sufficiently low to result in a hazard rating that is no greater than 'Danger to Some', as defined by DEFRA/EA FD2321.</p>	Figure B3c: Velocity (1% AEP)
	<p>What is the Hazard to People?</p> <p>Ensure that where development has to take place within an area with a risk from flooding that the hazard to people is no higher than 'Danger to Some', as defined by DEFRA/EA FD2321.</p>	Figure B3d: Hazard (1% AEP)
	<p>Is the site covered by Environment Agency Flood Warning Areas?</p> <p>Where the site lies within a Flood Warning Area, ensure that the development has a Flood Warning/Evacuation Plan and that it is signed up to the Environment Agency's Automated Flood Warning Service</p>	www.environment-agency.gov.uk
	<p>What is the effect of climate change on the flood extent?</p> <p>Ensure that mitigation measures take into account the effect of climate change on the various sources of flooding over the lifetime of the development.</p>	Figure B3a: Actual risk of fluvial flooding
Fluvial flooding from Ordinary Watercourses and Surface Water flooding	<p>Is there an Ordinary Watercourse within or adjacent to the site?</p> <p>Is the site within the Flood Map for Surface Water?</p> <p>Ensure that mitigation measures consider other sources of flooding and particularly those that may not be covered by the Environment Agency's Flood Zone Maps.</p>	<p>Figure B1: Study Area and Watercourses</p> <p>Figure B5: Flood Map for Surface Water</p>

4 How to use the SFRA in Development Management

4.1 Introduction

4.1.1 SFRA set the context within which all planning applications should be considered. This is done by establishing:

- the category of Flood Zone within which the proposed site sits;
- the flood risk constraints in accordance with guidance in the NPPF³ and its Technical Guidance⁴;
- planning constraints within designated development areas and windfall planning applications;
- the basis of KMBC's policies regarding proposed development in each Flood Zone; and
- the level of detail required for site-specific FRAs.

4.1.2 The SFRA should be used to provide high-level flood risk information for decisions on land use planning. This can be done on an "as required" basis, matching the needs of phased submission of applications.

4.2 Guidance for Developers

4.2.1 A developer is not required to apply the Sequential Test if a proposed development is located on a site which has been allocated for that type of development in a Local Plan and which has been sequentially tested and supported by a SFRA. However, a developer should still apply the sequential approach to any flood risk within the site itself and demonstrate compliance with the NPPF when determining the location of appropriate land uses within the site. The aim of the sequential approach is to minimise flood risk by considering the probability of flooding in conjunction with the vulnerability of receptors¹⁴.

4.2.2 Where development is proposed outside of the allocated areas in the Local Plan and within flood risk areas defined by the SFRA, applicants are responsible for demonstrating that the proposed application satisfies the outcome of the Sequential Test and if necessary the Exception Test. The evidence required for the Sequential and Exception Tests to be applied is likely to include:

- Information on the levels of flood risk on the site;
- Information on the availability of 'reasonably available'¹⁸ sites in areas of lower flood risk;

- Information on the vulnerability classification of the development;
- Information on the wider sustainability benefits of the site (if the Exception Test will need to be applied);
- Information to show that the development is safe.

4.2.3 In areas where flood risk has been identified as an issue, developers should liaise with KMBC to agree on who should be consulted. Pre-application discussions between KMBC, the Environment Agency and other relevant stakeholders should be used to scope out the availability of other sites that may meet the requirements of the application. It should also scope out what evidence will be required to show that other sites have been considered. The scope of any site-specific FRA should also be agreed with KMBC. This will be informed by the outputs from the Level 1 and Level 2 SFRA and in consultation with the Environment Agency where necessary.

4.2.4 Following the implementation of the Flood and Water Management Act 2010, Local Authorities are now responsible for the management of flood risk from local sources and are therefore responsible for, and should be consulted about, all sources of flooding other than from main rivers, the sea and large reservoirs. These remain the responsibility of the Environment Agency. The Environment Agency and United Utilities may also hold information on local sources of flooding.

4.2.5 Developers may want to consult with insurers to discuss the suitability of flood risk management measures and how this affects the overall insurability.

Flood Risk Assessments (FRAs)

4.2.6 The NPPF dictates that FRAs should be carried out to the appropriate degree at all levels of the planning process and to inform the application of the sequential approach. They should assess the risks of all forms of flooding to and from development taking climate change into account.

4.2.7 It is the responsibility of developers to consider the flood risk to a site as early as possible. Developers should refer to the SFRA at the start of any pre-application consultation with KMBC. Although the SFRA has been undertaken on behalf of KMBC, it does not negate the need for site-specific FRAs to be undertaken at the planning application stage. Instead, this SFRA provides advice on the scope of the additional information likely to be required within the FRA.

4.2.8 Planning applications for development proposals of 1 hectare or greater in Flood Zone 1 and all proposals for new development located in Flood Zones 2 and 3 will require a FRA. A FRA will need to demonstrate that flood risk to the development can be managed now and over the lifetime of the development. It

also should not increase the risk of flooding elsewhere and demonstrate that the proposals are compliant with local planning policy. The scope of a FRA should include the following key points, directed by the policy guidance and recommendations included in Chapter 6:

A description of the development and the planning context

- What is the development proposed and where will it be located?
- What are the proposed developments Vulnerability Classifications (see Table 2 of the Technical Guidance to the NPPF)?
- Is the proposed site consistent with Local Planning Policy, and has the Sequential Test or Exception Test been applied in the selection of the proposed site for the development type proposed?

Definition of flood hazard

- What sources of flooding could affect the proposed development site?
- For each source, describe the pathway and receptor of the flooding. Refer to historic records where available.
- What does the Flood Map for Surface Water indicate?
- What are the existing surface water drainage arrangements for the proposed development site?

Probability of flooding

- Which flood zone is the proposed development site within?
- What is shown within Volume 2 of the KMBC SFRA with respect to the different sources of flood risk at the proposed development site?
- What is the extent of flooding, including depth and velocities and hazard (see DEFRA/EA (2006) *Flood Risks to People*. FD2321/TR1¹⁹), on the proposed development site?
- What are the existing site runoff rates and volumes and how do they compare to the proposed rates and volumes of run-off generated by the proposed development?

Impacts of climate change on flood risk

- How is the flood risk at the proposed development site likely to be affected by climate change?

Detailed description of development proposals

- Details of the development layout, referring to relevant drawings.

- Where appropriate, demonstrate how land uses most sensitive to flood damage have been placed in areas within the site that are at least risk of flooding.

Flood risk management measures including the application of Sustainable Drainage Systems (SuDS)

- How will the site be protected from flooding, including the potential impacts of climate change, over the development's lifetime?
- How will the developer maintain flood defences (for sites adjacent to defences/watercourses)? The riparian owner is required to survey, renew and maintain the flood defences.
- What opportunities are there for the utilisation of SuDS in managing surface water, have they been optimised?

Impacts of the development off site

- How will the proposed development ensure it does not increase flood risk elsewhere, as a result of flood protection measures on site and run-off from the completed development?

Assessment of residual risk

- What forms of flood risk management are proposed for the site, for example, flood warning and evacuation?
- What flood related risks will remain after implementing flood risk management measures?
- A breach analysis may be required for developments close to a defended watercourse or the Leeds and Liverpool Canal. The parameters of the breach analysis should be agreed with the Environment Agency or British Waterways where relevant.
- How, and by whom, will these risks be managed over the lifetime of the development?

Consultation with the Environment Agency

4.2.9 Due to the large number of consultations and the variety of planning applications received by the Environment Agency they developed a consultation matrix which identifies when the Agency should be consulted, and what level of information needs to accompany the FRA if one is required. KMBC supports this process by identifying the extent of flood risk from different sources within the Borough and, with respect to fluvial flood risk, the extent, depth, velocity and hazard associated with flooding from modelled watercourses within this SFRA.

- 4.2.10 The Environment Agency consultation matrix is part of the Environment Agency's Flood Risk Standing Advice (FRSA), which is provided to Local Planning Authorities (LPAs) for more straightforward planning applications and is available on its website. The FRSA also allows LPAs to identify those higher risk development situations where consultation with the Agency is essential.

Consultation with United Utilities

- 4.2.11 The Knowsley area and the urban areas within it are extensively serviced by surface water, foul and combined sewers. Unless new development is to be located in an area in which soakaways can manage all surface water runoff or is directly adjacent to a watercourse, it is likely that development runoff will discharge to the local sewer network. This, however, is known to have limited capacity. Developers should therefore consult with United Utilities as early as possible in the formulation of development proposals in order to determine the capacity of the local drainage network to accept surface water runoff as well as potential connection points.
- 4.2.12 United Utilities' position is that development in any area may have difficulty in connecting to the public sewerage system. Its starting point for all developments is that surface water should not be connected to the public sewerage system unless it can be proved that this is the most sustainable option. Supporting this position, Part H of the Building Regulations presents a preferred hierarchy for the management of surface water runoff with discharge to soakaway preferred, followed by discharge to watercourse and then to sewer.
- 4.2.13 The Flood and Water Management Act 2010¹⁰ is set to remove the automatic right to connect to public surface water sewers. This may require developers to provide more justification than is currently required in order to connect to the United Utilities sewer network. It may in future be necessary to provide evidence that surface water runoff cannot be appropriately managed within the site through the use of soakaways or direct discharge to surface water in order to gain approval for connection to the public surface water sewer.
- 4.2.14 The Flood and Water Management Act 2010 is also set to establish SuDS Approval Bodies (SABs) within county, county borough or unitary local authorities. The SAB will have the responsibility for approving, adopting and maintaining drainage plans and schemes that meet National Standards for sustainable drainage. Drainage schemes will need to be approved before construction and this process is therefore likely to run in parallel with the planning approval process. The SAB elements of the FMWA have not yet been enacted; however, it will require developers to ensure drainage is designed to National Standards for SuDS and to consult with KMBC or the relevant SAB when

designing drainage systems.

Consultation with The Canal and Rivers Trust

- 4.2.15 There is only a small section of the Leeds and Liverpool Canal within the Knowsley Borough area. The canal is owned and managed by the Canal and Rivers Trust, formerly British Waterways, who must be consulted in relation to any development adjacent to its assets. The Canal and Rivers Trust have published the *Code of Practice for Works Affecting British Waterways* (August 2007)²⁰, which gives guidance and procedures to Developers, Local Authorities, Statutory Undertakers and their consultants when undertaking work that may affect the waterways. The Canal and Rivers Trust also publish *Waterways and Development Plans*²¹, which is intended to influence emerging local plans where there is an interaction with the waterways.
- 4.2.16 The Canal and Rivers Trust can advise of flood risk from a canal to a particular property. They can also provide guidance on the need to conduct more detailed analysis of the potential flood risk, at site level, from failure of Canal and Rivers Trust assets. This includes the need for and details of breach modelling. It should be noted that because of the managed nature of the waterway network and the unlikely and unpredictable nature of flooding from the waterway, flooding from the canal should be considered a residual risk. It should therefore be considered a potential source of flooding that should be considered within the flood risk management and design of the site rather than a source of flooding that should determine whether development takes place.

4.3 Guidance for Knowsley Metropolitan Borough Council

Introduction

- 4.3.1 This SFRA is a tool that should be used to ensure that flood risk is taken into account within its land use planning and management decisions. It can also be used to facilitate its flood risk management and land drainage functions and to ensure that flood risk is incorporated into its emergency planning.
- 4.3.2 Volume 2, in addition to the mapping of all sources of flooding, also presents assessments of each of the key development sites identified by the council as a potential allocation site within the emerging Local Plan. Each site assessment also includes guidance on the type and scale of flood risk management measures that might be required to demonstrate compliance with the NPPF. This information should be used as a guide to identify the level of detail required in a

²⁰ Code of Practice for Waterways, Canal and Rivers Trust, April 2010.

²¹ Waterways and Development Plans, Canal and Rivers Trust, February 2003.

FRA for those allocation sites and could prove useful when considering the prioritisation of bringing those developments forward.

4.3.3 The following sections outline how KMBC should use the SFRA:

- to define the scope of FRAs for new development;
- to review FRAs that are submitted in support of planning applications;
- to define potential Critical Drainage Areas;
- to support the implementation of Sustainable Drainage Systems (SuDS);
- to review the options for flood risk management within the Borough;
- to understand the opportunities for implementing new or retrofit flood resilience and resistance measures within the Borough;
- to take on board the implications of urban creep within the Borough; and
- to minimise the implications of cross-boundary flooding issues.

Scope of Flood Risk Assessments

4.3.4 This SFRA can be used by KMBC to provide guidance to developers on the scope required within a Flood Risk Assessment. This includes identifying the likely flood risk constraints within potential development sites.

4.3.5 Figure 4-1 outlines the process for assessing flood risk constraints and FRA scope.

4.3.6 Using information presented within this SFRA, together with the Council's Confirm database, KMBC can advise developers whether historical flooding records exist at or near to a site. KMBC can also advise the Environment Agency Flood Zone that the site lies within and whether there are nearby Ordinary Watercourses to consider within the assessment. Where available hydraulic models exist and information is presented within this SFRA then KMBC can also advise of the 'Actual' risk of flooding from fluvial sources as well as the impact of climate change and location of the functional floodplain. KMBC can also advise on whether there is a potential risk from groundwater, surface water and a residual risk from canal flooding or reservoir flooding. The information available from United Utilities can be used to identify potential sewer flooding constraints.

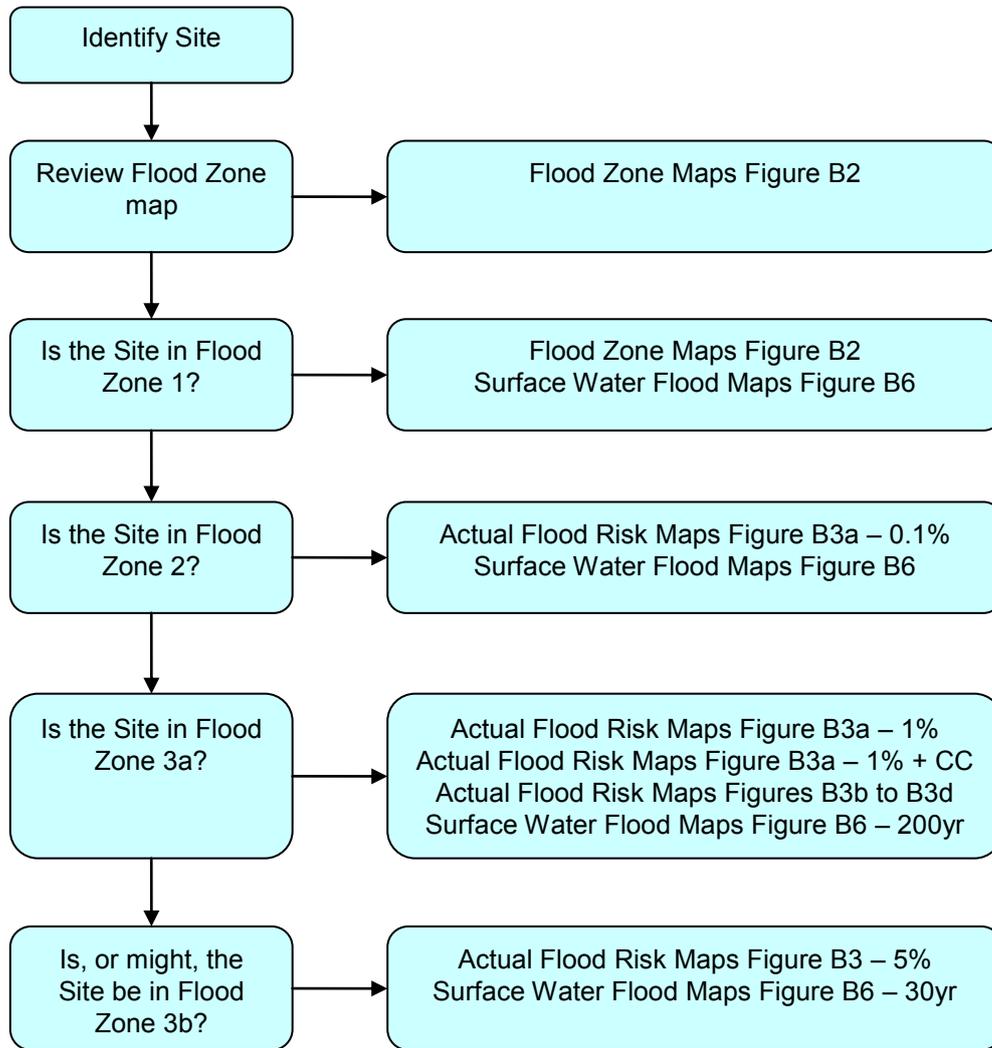


Figure 4-1: Process for assessing flood risk constraints and FRA scope

4.3.7 When all of the potential sources of flooding have been identified by KMBC, the typical scope of the FRA set out in Section 4.2 can be provided to the developer.

Assessing Flood Risk Assessments

4.3.8 Once a planning application, together with an appropriate FRA, is submitted by the developer, it should be assessed to ensure that flood risk from all sources has been considered and that flood risk will be managed, taking climate change into account.

4.3.9 It is the developer’s responsibility to provide sufficient detail to demonstrate compliance with the NPPF. It is therefore particularly important that pre-application discussions are conducted with KMBC, the Environment Agency, United Utilities and British Waterways where appropriate to avoid lengthy consultation following submission, or potential planning objections.

- 4.3.10 It is recommended that a precautionary approach be undertaken when making land-use planning decisions regarding flood risk. This is partly due to the considerable uncertainty surrounding flooding mechanisms and how flooding may respond to climate change. It is also due to the potentially devastating consequences of flooding to the people and property affected. FRAs should be reviewed to determine how the key principles of Assess, Avoid, Substitute, Control and Manage have been used to manage flood risk for new development in Knowsley.
- 4.3.11 Flood risk is a combination of the probability of flooding and the consequences of flooding. Hence 'managing flood risk' involves managing the probability of flooding, the consequences of flooding or both. Modern flood risk management involves identifying how the source, pathway or receptors¹⁴ can be managed to reduce flood risk.
- 4.3.12 In Knowsley, those responsible for assessing applications and in particular FRAs should ensure that the hierarchal approach to flood risk management has been adopted through:
- i. **Assess:** An appropriate FRA should accompany the planning application, which identifies the flood risk from all appropriate sources over the lifetime of the development, taking into account the presence of flood defences, residual risks associated with extreme events, asset failure or blockage and opportunities for providing flood risk benefits within Knowsley;
 - ii. **Avoid:** At the site level, an appropriate Sequential Test (and Exception Test where necessary) accompanies the planning application to show that the developer has considered locating the development within reasonably available¹⁸ sites at a lower risk from flooding. In addition the sequential approach at the site level should show that, where possible, high flood risk areas have not been developed;
 - iii. **Substitute:** the sequential approach has been applied within the development site, demonstrating that the most vulnerable elements have been located in the lowest probability flooding areas;
 - iv. **Control:** The following broad measures are often employed to 'control' flood risk.
 - Raising floor levels – managing both 'actual' and 'residual' flood risk and providing 'safe refuge' above flood levels. This is particularly relevant for areas in Knowsley that are at risk from fluvial flooding during the 1% AEP (1 in 100yr) or 0.1% AEP (1 in 1000yr) event even when defences are considered.

- Opening up culverts – within Knowsley there are a few watercourses, particularly the River Alt and parts of Kirkby Brook where there are culverted reaches. Where there are opportunities to open up the culverts and set back development from the open watercourse this should be encouraged. Setting back riverside defences and designing green, floodable storage spaces and routes for water can create a safe, attractive and well-connected development for both people and wildlife. This would also achieve betterment in connection with the Water Framework Directive (WFD).
 - Modification of ground levels – this approach can be used to reduce the depth of flooding during ‘extreme’ flood events. This approach, however, will need to be considered early in the design process as it can affect the overall layout and design, and impact upon neighbouring sites. Raising ground levels in areas at risk of fluvial flooding will generally not be suitable, unless it can be demonstrated that effective compensatory flood storage can be provided to prevent an increase in flood risk elsewhere;
 - Construction of new floodwalls or embankments – the Borough does not have extensive reaches of flood defence and there are no areas identified as Areas Benefiting from Defences, implying that the standard of protection (SoP) provided is not equivalent to a 1% AEP flood event. Where opportunities to improve the standard of protection or condition of existing defences are available this should be considered as part of development proposals. The existing defences on Netherley Brook do not provide a SoP equivalent to a 1% AEP flood event. As shown in the site assessments, the fluvial flood risk constrains development at the Greensbridge Lane site, therefore KMBC may wish to discuss with the Environment Agency opportunities for improving the SoP of these defences as part of the new development adjoining the brook. New defences to reduce the risk of fluvial flooding should be avoided, unless it can be demonstrated there are no other options available;
 - Sustainable Drainage Systems – where space is available and ground conditions are favourable, opportunities should be sought to maximise management of runoff via soakaway to reduce volumes and rates of water discharged to watercourses and sewers. Within developments SuDS such as swales, balancing ponds and wetlands should be promoted. Green roofs should also be promoted, especially in urban areas and on appropriate types of buildings.
- v. **Mitigate:** in accordance with the Sequential Approach, flood resilience and resistance measures in new buildings should only be used as a means to

manage relatively 'low' hazard or 'residual' flooding risk. Where development is exceptionally necessary (i.e. it passes the Exception Test), the ability to use flood resilience and resistance measures to manage flood risk should not be used as justification for new development.

4.3.13 Building Regulations do not currently allow for flood resilience and resistance measures, however, future proposed revisions may include additional guidance. Until this time, where developers are proposing the use of resilience and resistance measures to manage flood risk the following guidance should be consulted:

- Improving the Flood Performance of New Buildings: Flood Resilient Construction, CLG, June 2007
- Flood Resistance and Resilience Solutions: an R&D scoping study, DEFRA, May 2007
- Flood Resilient Homes: What homeowners can do to reduce flood damage, ABI

4.3.14 The hierarchal approach to managing flood risk should take account of climate change and should include an appropriate freeboard²² to allow for uncertainty, this is typically between 300mm and 600mm. Works to main rivers will need consent from the Environment Agency under the Water Resources Act 1991 and Land Drainage Act 1991 respectively. From 6 April 2012 Lead Local Flood Authorities (County Councils and Unitary Authorities) have been given responsibility for Land Drainage Consents on Ordinary Watercourses.

Critical Drainage Areas

4.3.15 The Town and Country Planning (General Development Procedure) (Amendment) (No. 2) (England) Order 2006 introduces the concept of Critical Drainage Areas (CDAs) as:

“an area within Flood Zone 1 which has critical drainage problems and which has been notified... [to]...the local planning authority by the Environment Agency”

4.3.16 In effect, land within a Critical Drainage Area either contributes to flooding at a critical location or acts as a pathway for the water that contributes to that flooding. Measures taken to manage flood risk within a CDA, such as to promote infiltration based SuDS or reduce surface water runoff to Greenfield rates, would therefore contribute towards a reduction in flood risk at that critical location.

4.3.17 Spatial analysis of the data available on sources of flooding within Knowsley and

²² The height of the top of a bank, floodwall or other flood defence structure, above the design water level (normally the water level that would occur disregarding any effects from wave action).

particularly of the datasets identifying the risk from surface water flooding and historical flooding incidents from surface water and sewers have been used to identify and define six key areas that could be considered for classification as Critical Drainage Areas. These are:

- Kirkby;
- Knowsley;
- Huyton;
- Prescott;
- Swanside; and
- Halewood.

4.3.18 Figure B10 presents the extent of these recommended CDAs. Some of these CDAs extend beyond the boundaries of KMBC, which highlights the importance of cross-boundary issues in flood risk management where the receptors of flooding are located in a different administrative area to the sources of flooding.

Sustainable Drainage Systems (SuDS)

4.3.19 It is widely recognised that SuDS are a useful tool in the management of flood risk and water quality. As a result, the use of SuDS in individual planning applications should be promoted.

4.3.20 The Flood and Water Management Act 2010¹⁰ set out in Schedule 3 details for the establishment of a SuDS Approval Body (SAB) which will most likely be the responsibility of KMBC as the Lead Local Flood Authority (LLFA). The SAB will be a statutory consultee of the planning process.

4.3.21 Schedule 3 of the Act, which is yet to be commenced, will require new drainage systems to be assessed and approved prior to construction. It requires that the drainage system meet new national standards (currently being consulted upon) for the design, construction, operation and maintenance of SuDS. If these National Standards are met then the SAB will be required to adopt and maintain the SuDS where they serve more than one property.

4.3.22 The Act also amends Section 106 of Water Industry Act (1991)²³ to make the right to connect surface water to public sewers conditional on the SAB approving the drainage system as meeting the National Standards. The SuDS provisions in Schedule 3 of the Act make no changes to the right to connect foul water to the public sewer system.

4.3.23 A review of available geological data suggests that the Sandstone deposits within

²³ Water Industry Act, July 1991.

the Borough should have reasonable permeability and may therefore be suitable for infiltration based drainage system. The Coal and Millstone Grit deposits of the Borough generally give rise to poor permeability therefore the potential for infiltration based drainage solutions in these areas may be limited. Overlying drift deposits also influence the suitability for SuDS, as this can allow or inhibit the infiltration of runoff into the underlying solid geology. For example, less permeable till deposits are likely to reduce the opportunities for the infiltration of rainfall into underlying strata, whilst permeable sand deposits are likely to facilitate infiltration.

- 4.3.24 Figure B11 presents a schematic of the potential to use SuDS to manage surface water. Areas identified as High Probability are those that combine permeable drift or no drift above Sandstone solid geology. The Medium Probability (1) class consists of those that are permeable drift above Coal Measures, whilst the Medium Probability Class (2) consists of impermeable/other types of drift above Sandstone solid geology. The Low Probability Class consists of impermeable/other types of drift above Coal Measures.
- 4.3.25 Overall Figure B11 indicates that opportunities for infiltration-based SuDS systems are likely to be highest in those areas around Kirkby in the north of the Borough, which lie in an area with both sand drift deposits and underlying sandstone solid geology, though there are isolated pockets of land that may however be favourable elsewhere. Away from Kirkby, it is likely that there will be fewer opportunities for infiltration-based SuDS systems, with limited opportunities in a band of land extending northwards from midway between Huyton and Prescott towards the eastern edge of Kirkby.
- 4.3.26 Where space is available within developments then SuDS such as swales, balancing ponds and wetlands should be promoted, though it should be acknowledged that these require space to be set aside for their operation, as well as having maintenance requirements. Green roofs are a valuable technique in the urban environment to reduce existing site runoff and KMBC should consider actively promoting their use. In February 2011 the Green Roof Organisation produced the Green Roof Code²⁴ for the United Kingdom. The code, which was the result of technical co-operation across the UK green roof industry, is intended to be recognised as a code of best practice and guide behaviour relating to green roof design, specification, installation and maintenance.
- 4.3.27 The use of possible infiltration-based SuDS should be investigated at a site specific scale when individual development sites come forward for development. Infiltration tests should be carried out as there may be opportunities for some

²⁴ The Green Roof Code, February 2011.

infiltration depending on local ground conditions. Infiltration to ground should be maximised and promoted ahead of discharge to watercourse or sewer in line with current requirements of Part H of the Building Regulations 2000²⁵. All soakaways should be in accordance with BRE Digest 365.

- 4.3.28 Historical industrial land uses in the Borough is likely to have resulted in a legacy of contaminated land in some locations. Where site investigation identifies unacceptable levels of contaminants in underlying soils this may limit any increase in infiltration on development sites due to the potential to negatively impact groundwater quality and consequential effects to surface watercourses. Additional consultation with the Environment Agency is recommended in this instance.

Flood Risk Management

- 4.3.29 The detailed information shown in Figure B3 shows that large areas of Knowsley are not at risk of fluvial flooding and at many of the assessment sites considered in the SFRA there is no risk of fluvial flooding. A few of the sites are shown to be at risk from fluvial flooding, however this risk would tend to constrain, rather than prevent development on site. The risk of fluvial flooding can be managed through the site specific measures outlined in the site assessments. More generally, opportunity for development may be increased in places through the improvement of existing flood risk management infrastructure. No new flood risk management infrastructure is recommended in this SFRA but there may be a requirement to maintain (or improve) existing infrastructure that protects assessment sites.
- 4.3.30 The conclusions of the site assessments included in this SFRA are that no new flood risk management infrastructure would be required for those assessment sites. The detailed modelling information shown in the Actual Risk flood maps (Figure B3) shows that none of the assessment sites in the north of the Borough (the Alt catchment) are at risk of fluvial flooding. In the south of the Borough (Ditton and Netherley Brook catchments), the assessment sites E41 and LDF9 on the Longwood Brook are not at risk of fluvial flooding but development at sites LDF7, H1 and LDF11 are at risk of fluvial flooding which will present a constraint to development here.
- 4.3.31 At sites H1 and LDF11 on the Netherley Brook, there is detailed information of the flood hazard from the Environment Agency 2D hydraulic model which should be used to inform the layout and development proposals of these sites. Development should be avoided within those parts of the site that are considered to be Functional Floodplain (see Figure B3). It may be possible to reduce flood

²⁵ Part H Building Regulations, 2000.

risk on the site through improvements to the existing defences on the brook. This should be discussed with the Environment Agency when sites are brought forward for development. Otherwise the risk at these sites can be reduced through careful planning of the development layout and detailed design proposals.

- 4.3.32 At site LDF7 on the Childwall Brook, the Environment Agency hydraulic model shows that a significant proportion of the site is within the 1% AEP flood extent and some of the site is likely to be in the Functional Floodplain because of the design capacity of the culverted Childwall Brook through the site. The depth of flooding on the site is generally less than 0.3m, although close to the brook potential depths do rise to over 0.5m in places in the 1% AEP flood extent. The type of model used in this case does not allow a detailed assessment of flood hazard and velocity. There are no existing flood defences protecting the site from flooding. It is recommended that flood risk be managed through a sequential approach to the development layout and detailed design avoiding the need for new flood risk management infrastructure where possible. Unless development on those parts of the site at risk from flooding can be avoided, there may be a requirement for ground raising, to reduce the risk of flooding. Any ground raising would have to be mitigated through the provision of compensatory storage so that the risk of flooding is not increased elsewhere as a consequence of the development.

Flood Resilience and Resistance

- 4.3.33 Although there are not extensive areas at risk from fluvial flooding within the Borough there are areas in which the risk from surface water and sewer flooding is significant and in which there are limited opportunities to implement short term solutions. Given the nature of these flooding mechanisms, there are likely to be many areas that would benefit from the installation of measures that increase the resilience of a property to flooding, i.e. they quicken the time of recovery and reduce the damage done in the event of a flood and therefore reduce the cost of the consequences of flooding. This should be implemented for new development in which there is a residual risk from flooding but it is also recommended that Knowsley Metropolitan Borough Council promote the retrofitting of flood resilience and resistance measures or Individual Property Protection (IPP) measures where opportunities allow.
- 4.3.34 Examples of flood resilience measures might include waterproof plaster on the walls, solid concrete floors rather than wooden floors and electric circuitry raised above the flood level. Similarly, measures can be installed that increase the resistance of a property to flooding. Resistance measures prevent or reduce the likelihood of ingress of flood water and can include measures such as air brick

covers, flood gates for doorways and windows and no-return valves for drainage pipes.

- 4.3.35 Guidance from CLG in *Improving the Flood Performance of New Buildings: Flood resilient construction (2007)*²⁶ indicates that most buildings that are impacted by flooding to a depth of greater than 100mm may benefit from resistance measures. These are likely to be effective when depths are relatively shallow and potentially up to approximately 0.6m. Above this, and inevitably in some cases below this value, flood water is more than likely to ingress through an unprotected pathway and flood resilience measures become more appropriate.
- 4.3.36 Assessment of the Flood Map for Surface Water (FMfSW) 200yr (deep) dataset would suggest that there are isolated areas of Kirkby, Huyton, Prescott and Halewood that might benefit from flood resilience and resistance measures. Further assessment of the FMfSW outlines against the National Receptor Database has been undertaken to count properties at risk and to identify where there may be benefits from retrofitting flood resilience and resistance measures. The definition of acceptability is based on the CLG guidance above, in which it is recommended that depths below 0.3m are potentially appropriate for flood resistance measures and depths that are less than 0.6m are potentially appropriate for flood resilience measures.
- 4.3.37 Using this criteria, the 30yr Flood Map for Surface Water dataset identifies at least 1,267 ground floor properties at risk from flooding whilst the 200yr dataset identifies at least 4,792 properties at risk from flooding. Of these 1,032 and 4,156 properties respectively are homes and the remainder are businesses and other uses that may benefit from flood risk management measures.
- 4.3.38 The 30yr (deep) Flood Map for Surface Water dataset identifies at least 179 properties at risk from flooding that is greater than 0.3m, whilst the 200yr (deep) dataset identifies at least 1,006 properties at risk from flooding that is greater than 0.3m. The potential depth of flooding at these properties implies that flood resilience measures may be suitable, whilst for the remainder flood resistance measures may also be appropriate.

Urban Creep

- 4.3.39 A recent study by Martin Allitt and Andrew Tewkesbury²⁷ investigated the problem of urban creep in five cities across the UK. Urban creep is the loss of permeable surfaces within urban areas, typically development like extensions, patios and paving of front gardens to create off-street parking, all of which were until recently forms of permitted development. The latter, paving of front gardens, has now

²⁶ CLG, *Improving the flood performance of new buildings: flood resilient construction*.

²⁷ Allitt, M & Tewkesbury, A (2009) *Investigations into Urban Creep at 5 Cities*

become more restricted, however, the remainder continue to be forms of permitted development under certain conditions.

- 4.3.40 The five cities investigated were Leicester, Maidstone, Chester, Norwich and Newcastle-Upon-Tyne. Advanced analysis of land cover was undertaken from high resolution aerial imagery in order to identify those areas in which urban creep has taken place. The research took care to remove 'growth', such as new properties or the addition of paved areas associated with new properties as well as major highway improvement schemes. The remaining changes were considered to be urban creep.
- 4.3.41 The study found differences in rate of urban creep between cities and also between property types. As might be expected, detached houses were shown to expand by more than twice the amount of semi-detached and three times as much as terraced housing. It was found that the average rates of urban creep were between 0.4 and 1.1 sq m/house/year depending on the city.
- 4.3.42 A similar recent study focussed on urban creep in Scotland²⁸ suggests that solutions should be promoted through legislation, education and incentives. Solutions may include measures similar to the recent changing of permitted development rights for the paving of front gardens.
- 4.3.43 For the reasons outlined above, it is strongly recommended that KMBC consider investigating the likely location and extent of potential urban creep within the Borough. The aim of such investigation would be to determine whether the likely location of urban creep coincides with areas of historical and possible future surface water flooding and whether it could contribute to an increase in flood risk within critical drainage areas. Where the location of urban creep coincides with areas of known or potential future risk the Council should consider whether there is sufficient evidence to further restrict permitted development rights (e.g. classes A.1 and E.1 in addition to F.1) to minimise the contribution that urban creep has on surface water and sewer flooding.
- 4.3.44 Reference should also be made to Communities and Local Government document 'Guidance on the permeable surfacing of front gardens'. The document explains the different approaches to constructing a driveway or other paved area that controls and reduces rainfall runoff into drains by using permeable surfaces or soakaways and rain gardens.

Cross-boundary Issues

- 4.3.45 The two principal catchments within which Knowsley lies are those of the River

²⁸ G. B. Wright, S. Arthur, G. Bowles, N. Bastien & D. Unwin. (2011). Urban creep in Scotland: stakeholder perceptions, quantification and cost implications of permeable solutions. *Water and Environment Journal*, Chartered Institute of Water and Environmental Management.

Alt and Ditton Brook.

- 4.3.46 The area draining to the River Alt where it leaves Knowsley includes Simonswood Brook, which drains rural areas along the edge of Sefton District, rural areas within West Lancashire and a small area of St. Helens to the north and west of Kirkby. Runoff from this area has the potential to influence flood risk within Kirkby. Other areas that drain into the River Alt into Knowsley include Fazakerley, West Derby, Walton and Anfield. These drain via Fazakerley Brook and only affect a small area to the north of Gillmoss.
- 4.3.47 Elsewhere, areas of Childwall, Gateacre, Woolton and Netherley in Liverpool District, rural areas of St. Helens to the south west of Rainhill and some areas of Ditton in Halton District contribute to flow within Ditton Brook via Netherley Brook, Fox's Bank Brook and drains respectively.
- 4.3.48 There are also contributions from Knowsley District into adjacent districts that must be acknowledged. The River Alt catchment drains into Sefton District to the north west, contributing to flood risk in Maghull and indirectly to Formby. A small area of Knowsley contributes to flow into St. Helens District that ultimately contributes to flow in Sankey Brook and a small area of Knowsley contributes to flow in Ram's Brook in Halton District.
- 4.3.49 In light of the above, it is strongly recommended that Knowsley Metropolitan Borough Council work closely with these neighbouring authorities to identify and manage cross-boundary issues through joint approaches to development management and planning policy. It is acknowledged that the Local Plan programme of each of these Boroughs is likely to be at different stages and that this may not therefore be easy to coordinate. At the very least it is recommended that KMBC discuss and understand the cross-boundary issues with its partner authorities to ensure that processes are in place to pick up opportunities and issues when they arise.

5 Flood Warning and Emergency Planning

5.1 Introduction

- 5.1.1 Flooding is a natural process that plays an important role in shaping the natural environment. However, flooding also threatens life and causes substantial damage to property. Although flooding cannot be wholly prevented, its impacts can be avoided and reduced through good planning and management. While physical defences may provide a level of protection, they may be breached or overtopped. A necessary component of flood defence is flood warning, backed up by civil protection measures. In this context, the Environment Agency is the authority responsible for issuing forewarning of possible flood events to the public, local authorities and emergency services.
- 5.1.2 Structures and procedures for civil protection were drawn up under the Civil Contingencies Act 2004²⁹ which came into force in November 2005. Under the Act, local risk assessment and planning is arranged through Local Resilience Forums (LRF). For Knowsley this is the Merseyside Resilience Forum. The LRF publishes a Community Risk Register on its website that collates assessments of risk from primarily non-malicious events (that is hazards), including flooding³⁰.
- 5.1.3 Category 1 responders are considered to be 'Core Responders', which consist of the Emergency services, local authorities, health bodies, such as the Primary Care Trusts and Government agencies. Knowsley Metropolitan Borough Council and the Environment Agency are defined as Category 1 responders. Category 1 responders are responsible for risk assessment and contingency planning to deal with emergencies together with the provision of advice and information to the public about actual or likely emergencies.
- 5.1.4 Category 2 responders are also involved in emergency planning and response. Category 2 responders are considered to be 'Co-operating responders' and include utilities companies, transport operators, some health bodies and some Government agencies. United Utilities is a Category 2 responder. Potential changes to the Civil Contingencies Act as part of the Civil Contingencies Act Enhancement Programme may include refining duties for local resilience forums and Category 1 and 2 responders.
- 5.1.5 The Community Risk Register, published by the Merseyside Resilience Forum, indicates that local / urban flooding from fluvial or surface runoff has a 'Very High'

²⁹ Civil Contingencies Act 2004,

³⁰ Merseyside Community Risk Register, 2011.

risk rating, local fluvial flooding has a risk rating of 'High' and major reservoir dam failure or collapse has a risk rating of 'Medium'. These assessments, however, are Merseyside-wide and don't reflect Knowsley's specific flood risk as outlined in Sections 2 and 4.

- 5.1.6 As well as the Community Risk Register, Multi Agency Flood Plans (MAFPs) are also prepared by the LRF. The Merseyside MAFP, which is currently under review, will set out how all responding parties should work together in an agreed and coordinated response to flooding. It will cover all sources of flooding except foul sewers, burst water mains and private lakes and canals. The document will present an overview of the flood risk within Merseyside and define triggers for activating the MAFP and what the local response should be. It identifies administrative responsibilities during a response and appropriate communication guidelines.
- 5.1.7 Part 2 of the MAFP is local to and prepared by Knowsley Metropolitan Borough Council. KMBC's MAFP (May 2010) is owned by the Regeneration Directorate and sets out the specific arrangements within the Borough. It identifies the resources, responsibilities and actions to be taken by the Council in dealing with flooding incidents. The objectives of the plan are as follows:-
- Establish a management process which clearly identifies roles and responsibilities;
 - Outline the Council's response to flooding from watercourses, groundwater and surface water;
 - Liaise with and engage with local communities and vulnerable people (which may be achieved in combination with other initiatives); and
 - Identify the local critical infrastructure assets, highlight risk and establish emergency contact.
- 5.1.8 The Part 2 MAFP identifies a number of responsibilities for the personnel of KMBC, both in terms of pre-planning for a flood event, the emergency response, and recovery. The outputs of this SFRA will help with the following pre-planning responsibilities:
- Maintaining an up-to-date vulnerable persons and sites database;
 - Identifying suitable locations for rest, reception and media centres;
 - Completing pre-multi-agency planning, such as identification of transport routes;
 - Review of Council properties at risk and the vulnerability of the community affected;

- Understanding the spatial variability of the hazards posed by breach failure in either a canal or a reservoir; and
- Providing updated information on the Council website.

5.1.9 There are a number of major infrastructure routes within the Borough of Knowsley; the following key points should be noted:

- The A506 is shown to be within Flood Zone 3 to the north east of Kirkby (NGR 340540, 400600) and to the south west of Kirkby (NGR 340720, 398440). There is no detailed modelling to confirm otherwise;
- The Wigan Line crosses Kirkby Brook in Kirkby at NGR 340850, 399550. The Kirkby Brook has not been modelled so no detailed information about the level of risk at this location can be provided;
- The M57 at Junction 6 crosses Kirkby Brook and parts of the motorway between Junction 4 and 6 are shown to be at within Flood Zone 2 from a combination of the River Alt, Croxteth Brook and Knowsley Brook. This also affects the A5207 and the A580 This is beyond the extents of the Environment Agency River Alt model so no detailed information about the level of risk at this location can be provided;
- A small section of the A526 is shown to be within Flood Zone 2 associated with the River Alt in Huyton. This is beyond the extents of the Environment Agency River Alt model so no detailed information about the level of risk at this location can be provided;
- A small section of the M57 is shown on Flood Zone Maps to be within and bordering Flood Zone 3 associated with Prescott Brook between Huyton and Prescott, this also crosses the path of two railway lines to Preston and Manchester. Detailed modelling would suggest that there is a no impact to these transport routes, however, there may be a risk of scour as velocities in the channel are between 0.5 and 1.0m/s in the 1% AEP event on the approach to the culverts under the railway and motorway;
- The A5300 south of Junction 6 of the M62/M57 crosses Flood Zone 3 associated with Dog Clog Brook;
- The railway line from Liverpool South Parkway to Widnes, Warrington and Manchester also crosses the floodplain of Ditton Brook;
- The junction of the A561 and the A5300 where Ditton Brook passes beneath it is shown to be within Flood Zone 3;
- A United Utilities Wastewater Network Pumping Station at the Lower Road

is shown to be within the extent of Flood Zone 3 associated with Ditton Brook at NGR 345975, 385934;

- Areas of Stadt Moers Country Park are affected by Flood Zone 3 associated with Prescott Brook; and
- There are two listed buildings shown to be within Flood Zone 3, Kirkby Hall Lodge, and Tarbock Hall Farmhouse.

- 5.1.10 It is important that those leading on flood prevention and response within KMBC work closely with Planning and Development Management colleagues to make use of this SFRA. This SFRA will support KMBC in the identification of risks in the Borough and will help to facilitate joined-up local planning, based on consistent planning assumptions.
- 5.1.11 The information from the SFRA will be used to feed into land use planning decisions at the strategic scale down to the individual site scale. Inappropriate development in flood risk areas can pose a significant risk to life, especially to the young, elderly and infirm. It is essential that new development that takes place within flood risk areas is safe and that they are designed and constructed such that the health, safety and welfare of people are appropriately managed. This is of particular importance to developments which proceed following the application of the Exception Test.
- 5.1.12 The spatial distribution of flood hazard should also inform the production of emergency flood management plans. Emergency flood management plans should minimise risks to life and property, through, for example, ensuring that evacuation procedures are adequate for the kinds of risks that a major flooding event may create.

6 Policy Guidance and Recommendations

6.1 Introduction

6.1.1 This chapter of the SFRA provides recommendations with regards to the development of flood risk policy by Knowsley Metropolitan Borough Council. It includes consideration of flood risk management techniques, as well as providing guidance on sustainable drainage requirements. These recommendations are based on the findings of this SFRA, and current national policy and guidance.

6.1.2 The list of recommendations is not exhaustive and it is therefore recommended that KMBC additionally refer to key flood risk management documents and spatial planning documents to inform the development of its policies. The documents to be considered include the following:

- The National Planning Policy Framework³ and its supporting Technical Guidance⁴;
- Making Space for Water³¹;
- The North West Regional Spatial Strategy³²;
- The North West Regional Flood Risk Appraisal¹⁶;
- Knowsley Council PFRA¹¹;
- Alt Crossens Catchment Flood Management Plan¹²; and
- Mersey Estuary Catchment Flood Management Plan¹³.

6.1.3 These recommendations have been taken into consideration when assessing the sites being considered for allocation.

6.1.4 Although there are areas at risk from fluvial flooding, the key flood risk within Knowsley is from surface water and sewer flooding and there are areas in which groundwater will contribute to these risks.

6.1.5 The probability of flooding from surface water can be reduced on new developments by reducing the flow and volume of runoff from the site. Runoff should be controlled as close to the source as possible through the use of SuDS. The layout of sites should be designed so that areas at greatest risk of surface water flooding are avoided and that flow paths are maintained with no loss of storage on site.

³¹ Making space for water: Taking forward a new Government strategy for flood and coastal erosion risk management in England, March 2005

³² North West Regional Spatial Strategy: The North West Plan, 4NW, September 2008.

- 6.1.6 Knowsley Metropolitan Borough Council must consider how to respond to the risk outlined above. The risk of surface water flooding is significant, the probability (chance) of occurrence is quite high but the consequences of the event are typically quite low or at least localised. The risk is heavily influenced by the extremely urban nature of the settlements within Knowsley and there may be only a limited opportunity in the short term to mitigate the probability or consequences of flooding.
- 6.1.7 As part of this SFRA, recommendations for development management and planning policy have been identified and they are presented in Table 6-1 and Table 6-2, overleaf.

Table 6-1: Policy Recommendations for Development Management and Flood Risk Assessments

Category	DC Policy and FRA Recommendations	FZ3a, FZ3b, FZ2	FZ1 (greater than 1ha)	Within areas of Local Flood Risk (i.e. surface water, sewer and groundwater)	Near Rivers (whether in a floodplain or not)
1. Rivers					
Ensure	An 8m wide undeveloped buffer strip should be provided alongside river corridors to allow for maintenance access				✓
	There should be a presumption against further culverting unless for access.				✓
	Developers should seek opportunities to deculvert/undertake river restoration				✓
2. SuDS					
Policy Requirements	An assessment of surface water flood risk should be undertaken on all sites.	✓	✓	✓	✓
	New Greenfield development to restrict runoff to existing rates and, where possible, volumes and to seek to maximise discharge to first soakaway, then watercourse and then sewer.	✓	✓	✓	
	All new development across the Borough to include at least one 'at source' SuDS measure. Where no 'at source' SuDS measure is proposed, provide evidence to show that such measures are not feasible as a result of existing ground conditions.	✓	✓	✓	
	New Brownfield development should seek to reduce runoff by at least 50% from existing rates and volumes. This can be achieved through discharging to soakaways as well as through the provision of storage devices and by flow restriction devices that discharge at low rates during and after a storm. The use of infiltration methods must be balanced against groundwater flood risk and contaminated land issues on Brownfield sites.	✓	✓	✓	
3. Local Sources of flooding					
Ensure	Risk of flood from other local sources of flooding, i.e. surface water, groundwater, canals and reservoirs, must be fully considered and mitigated.	✓	✓	✓	
4. Reducing flood risk					
Policy requirements	Policy on flood risk should contribute to the objectives of the Alt Crossens and Mersey Estuary Catchment Flood Management Plans where appropriate.	✓	✓		
	Policy on flood risk should contribute to the North West River Basin Management Plan ³³ objectives through which the objectives of the Water Framework Directive ³⁴ may also be met.	✓	✓		
	Policy on flood risk should aim to achieve a reduction in the risk of flooding	✓	✓	✓	
Assess	Provide a clear and concise statement summarising how the proposed redevelopment has contributed to a positive reduction in flood risk.	✓	✓	✓	
	FRAs supporting proposed development should assess the proposed development against all elements of the Council's flood policy.	✓	✓	✓	
	Undertake a Flood Risk Assessment in line with the requirements of the NPPF ³	✓	✓	✓	
	Details of site levels to Ordnance Datum should be provided	✓	✓	✓	
	The potential of the development to increase flood risk elsewhere should be identified	✓	✓	✓	

³³ North West River Basin Management Plan, December 2009.

³⁴ EU Water Framework Directive (2000/60/EC)

Category	DC Policy and FRA Recommendations	FZ3a, FZ3b, FZ2	FZ1 (greater than 1ha)	Within areas of Local Flood Risk (i.e. surface water, sewer and groundwater)	Near Rivers (whether in a floodplain or not)
	Opportunities to reduce the vulnerability classification of the site through the site's redevelopment should be identified	✓		✓	
	The vulnerability of the development to flooding over the lifetime of the development (e.g. max water levels, flood extents, flow depths, flow velocities flow paths and hazard).	✓	✓	✓	
Ensure	Where necessary a Sequential Test must be undertaken and approved by the LPA.	✓	✓		
	The Sequential Approach has been clearly applied	✓	✓	✓	
	An FRA is undertaken in line with the NPPF and Environment Agency's Standing Advice website.	✓	✓	✓	
	If Water Compatible Development or Essential Infrastructure is proposed in Flood Zone 3b then the Exception Test will need to be satisfied and a detailed FRA will be required. No other forms of development can be proposed in this zone.	✓			
	The development does not increase flood risk, providing level for level floodplain storage compensation where necessary.	✓			
	The development provides 'safe' access, i.e. access that is <u>dry</u> for 'more' and 'highly vulnerable' uses.	✓			
	Ground floor levels are set at least 600mm above the 1 in 100 year flood level including an allowance for climate change.	✓		✓	✓
	Ground floor levels to be set at an appropriate height above surrounding ground levels to ensure surface water cannot enter	✓	✓	✓	
	Conveyance/storage is improved.	✓		✓	
	Flow routes are preserved.	✓		✓	
	Opportunities to reduce the size of existing building footprints have been explored	✓		✓	
The site is designed sequentially and where possible buildings are removed and the natural floodplain restoration.	✓			✓	
5 Reducing residual flood risk					
Policy requirements	Implement as per category 4, above				
Assess	Residual risk of flooding considers actual risk of flooding in extreme events and also failure of infrastructure. Develop a flood risk management strategy for development accordingly.	✓			
Ensure	Where necessary a Sequential Test has been undertaken and approved by the LPA.	✓	✓	✓	
	An FRA is undertaken in line with the NPPF ³ and Environment Agency's Standing Advice website	✓	✓	✓	
	If Water Compatible Development or Essential Infrastructure is proposed in Flood Zone 3b (functional floodplain) then the Exception Test will need to be satisfied and a detailed FRA will be required. No other forms of development can be proposed in this zone.	✓			

Category	DC Policy and FRA Recommendations	FZ3a, FZ3b, FZ2	FZ1 (greater than 1ha)	Within areas of Local Flood Risk (i.e. surface water, sewer and groundwater)	Near Rivers (whether in a floodplain or not)
	The development should not increase flood risk. This should be achieved by maintaining or reducing flood levels and not impacting overland flow routes.	✓	✓	✓	
	The development provides safety by setting floor levels to 600mm above the 1 in 100 year residual risk flood level for 'more' and 'highly vulnerable' development. Safe access for 'less vulnerable' development may be to a suitable refuge within the building 300mm above the 1 in 1000 year residual risk flood level or to Flood Zone 1.	✓			
	Opportunities to reduce the size of existing building footprints are explored.	✓		✓	
	The site is designed using the sequential approach.	✓		✓	

Table 6-2: Recommended Planning Policy Guidance

Recommended Guidance	Policy	Reference in the SFRA	Policy Support	
Forward Planning				
1		Although the Borough has a relatively small area within Flood Zone 2 and 3, KMBC should seek opportunities to apply the NPPF ³ principle of 'avoiding flood risk' by, wherever possible, allocating development outside of Flood Zone 2 and 3 and areas in Flood Zone 1 identified at high risk of surface water flooding.	Vol. 1 Chapter 3	NPPF
2		'More vulnerable' development should be avoided in areas identified at 'actual risk' of fluvial flooding (Also refer recommendation 3, 11 and 14).	Vol. 1 Chapter 4 Figs B.3a – B.3d	NPPF
3		Where recommendation 2 is not possible, a sequential approach to the location of development across the Borough should be adopted, allocating the most vulnerable development in the lowest risk flood zones.	Vol. 1 Chapter 3 and Vol. 2 Mapping	NPPF
4		Where development is required in Flood Zone 2 or 3, it should be supported by a robust Sequential Test that demonstrates recommendation 1, 2 and 3 have been performed.	Vol. 1 Chapter 3	NPPF
5		KMBC should work with those planning and maintaining local or regional 'essential infrastructure' across the Borough to ensure it remains operational during flood conditions and is adaptable to the effects of climate change. This should focus on ensuring that all future investment in strategic infrastructure includes provisions for equipment and built environment to remain operational during "residual risk" flood events (flood emergencies). This is particularly relevant for the rail network, M62 and M57, various A roads, electricity sub-stations and United Utilities' Pumping Stations.	Vol. 1 Chapter 5 Table 6.1, Vol. 1 Chapter 6	NPPF North West RFRA
6		Where development is required in Flood Zone 2 or 3, KMBC should consider whether existing vulnerable development can be relocated to lower risk areas, and vice versa. In particular opportunities to locate open space currently in Flood Zone 1 to areas at higher probability of flooding and to use the open space in Flood Zone 1 to locate development outside of the floodplain. Existing green space in Flood Zone 2 and 3 should be retained, and enhanced where possible, to reduce flood risk overall.	Vol. 1 Chapter 4	NPPF Liverpool City Region Green Infrastructure Framework
7		Where the NPPF ³ requires the Exception Test to be applied for site allocation, KMBC should ensure the wider sustainability benefits of development, and how these outweigh flood risk, are clearly documented with reference to the Sustainability Appraisal (part a of the Exception Test).	Vol. 1 Chapter 3	NPPF
8		Vol. 2 Site Assessments of the SFRA should be used to inform the site selection process for the Local Plan. The proforma used in Vol. 2 can be used by KMBC to assess further sites in more detail	Vol. 2 Site Assessments	
9		In critical drainage areas that are susceptible to surface water flooding, develop measures to manage, and where possible, reduce the existing risk.	Vol. 1 Chapter 4	NPPF Alt Crossens CFMP

Recommended Guidance	Policy	Reference in the SFRA	Policy Support	
				Mersey Estuary CFMP
10		Encourage the local community in flood risk areas to take up opportunities to improve resilience and resistance of existing homes and buildings.	Vol. 1 Chapter 4	Alt Crossens CFMP Mersey Estuary CFMP
Development Management				
11		KMBC should develop a policy statement on the use of the Sequential Test and Exception Test, both for site allocations and windfall sites, including definition of 'reasonably available' ¹⁸ .	Vol. 1 Chapter 3	NPPF
12		KMBC should apply the 'Substitute' principle of flood risk management by ensuring new development adopts a sequential approach within site layout, wherever possible – locating the most vulnerable uses in the lowest risk areas.	Vol. 1 Chapter 3	NPPF
13		Some investment in flood defence infrastructure may be required in KMBC in the future. The Council should seek to improve flood defences as development occurs, considering: <ul style="list-style-type: none"> • defence condition; • CFMP policies; and • Developer contributions policy discussed in recommendation 23. 	Vol. 1 Chapter 5 Vol. 1 Chapter 6	Alt Crossens CFMP Mersey Estuary CFMP
14		KMBC should consider obligations for developers on sites bordering defended sections of watercourse and their tributaries to maintain and improve flood defences for the lifetime of the development, either directly or through contributions for strategic management (refer recommendation 23). This should be informed by the EA System Asset Management Plans, and be agreed with the Environment Agency.	Vol. 1 Chapter 2	Alt Crossens CFMP Mersey Estuary CFMP
15		All development bordering defended sections of watercourse and their tributaries should seek opportunities to set back defences in accordance with the principles of 'Making Space for Water'. They should also ensure maintenance and improvement arrangements are in place so that flood defences will remain in a satisfactory condition to function as designed for the lifetime of the development. This should include an undeveloped buffer strip along all main rivers to provide opportunities for restoring the river corridor, provision of flood storage and conveyance and future adaptation of flood defences where appropriate. In addition the undeveloped zone is for flood authorities to retain access for maintenance and emergency access when required. Individual planning applications must adopt the Environment Agency requirements for 8m buffer strips on main rivers wherever possible.	Table 6.1, Vol. 1 Chapter 6	Alt Crossens CFMP Mersey Estuary CFMP Water Resources Act 1991 Land Drainage Act 1991
16		In line with the principles of the Water Framework Directive ³⁴ , KMBC should adopt a presumption against further culverting of watercourses and seek opportunities to de-culvert, with consideration of site and ground conditions.	Table 6.1, Vol. 1 Chapter 6	Land Drainage Act 1991 and Land Drainage Byelaws

Recommended Guidance	Policy	Reference in the SFRA	Policy Support	
17		Planning and Development Management should formally consult with those leading on flood prevention and response within KMBC on all proposed development sites in Flood Zone 2 and 3, and in Flood Zone 1 areas greater than 1ha and identified as at high risk of surface water flooding, so informed decisions can be made on the available capacity to respond to flood emergencies.	Vol. 1 Chapter 5	
Emergency Planning				
18		The findings of this SFRA, and future revisions, should be incorporated into KMBC's Multi Agency Flood Plan and into the flood risk assessments contained within the Merseyside Community Risk Register ³⁰ .	Vol. 1 Chapter 5	
19		The Multi Agency Flood Plan should consider necessary action so that essential infrastructure in KMBC can return to operation as quickly as possible following emergency flood events.	Vol. 1 Chapter 5	
20		KMBC should identify vulnerable people in the floodplain and develop plans to assist or protect them.	Vol. 1 Chapter 5	Alt Crossens CFMP Mersey Estuary CFMP
21		Use the SFRA to communicate the risk of flooding to the local community and improve flood awareness.	Vol. 1 Chapter 5	Alt Crossens CFMP Mersey Estuary CFMP
22		KMBC should work with providers to ensure key utilities across the Borough will continue to operate under flood conditions. This would ensure that communications, power, civil emergency response, etc were made more resilient and adapted to the potential for a serious flood emergency	Vol. 1 Chapter 5	
Flood Risk Management				
23		KMBC should develop a contributions policy and introduce guidance for developers which addresses the need to manage flood risk and fund necessary improvements, strategically across the Borough. KMBC should work closely with the Environment Agency in applying Alt Crossens CFMP ¹² and Mersey Estuary CFMP ¹³ policy recommendations to identify how contributions should be used.		NPPF Alt Crossens CFMP Mersey Estuary CFMP
24		<p>In conjunction with recommendations 15 and 16, the Council should seek measures to reduce flood risk (both the probability and consequences) as part of new development. This could include considering measures such as:</p> <ul style="list-style-type: none"> • Opportunities to 'design out' raised defences'; • Site-specific secondary defences; • Ground raising; or • Using lower vulnerability land uses around the perimeter of a development to act as a secondary flood storage area to higher vulnerability development within the centre. 		

Recommended Guidance	Policy	Reference in the SFRA	Policy Support	
		It will need to be demonstrated that measures to reduce flood risk in one area do not result in an increase in flood risk to others.		
25		KMBC should be consulted on any proposed development that could affect flood risk in the Borough. This includes sites affecting Simonswood Brook, Fazakerley Brook, Netherley Brook and Fox's Bank Brook that lie outside of the Borough.	Vol. 1 Chapter 4	
26		<p>Following the application of the Sequential Test, where proposed development is necessary in areas at 'actual risk' of fluvial flooding (1 in 100 year return period, plus climate change), or high risk of surface water flooding, it must be 'safe' in accordance with the NPPF³ including measures such as:</p> <ul style="list-style-type: none"> • Setting all 'more vulnerable' finished floor levels, and any basement access thresholds, a minimum of 600mm above 100 year modelled flood levels plus an allowance for climate change; • In certain circumstances some flexibility of the above may be acceptable, but will depend on further assessment of the vulnerability of the land use and the nature of the flooding, as well as other controls being in place such as warning and evacuation measures and the use of flood resilience and resistance; • Dry access is available for 'more vulnerable' and 'highly vulnerable' development, preferably including dry vehicular access that enables voluntary and free movement out of the floodplain. If it can be demonstrated that this is not feasible then 'safe access' in accordance with FD2320³⁵ is appropriate. • Appropriate flood warning and emergency planning is available to enable 'less vulnerable' site users to safely evacuate the site and floodplain prior to the onset of flooding; • Development demonstrates there is no increase in flood risk as a result of development, in particular no loss of flood storage; • 'Essential infrastructure' remains operational during flood conditions, including access where necessary. • Demonstrate emergency services can safely access the site, and site users, where necessary. 	Vol. 1 Chapter 2 Vol. 1 Chapter 4 Figs B.3a to B.3d Figs B.6	NPPF Alt Crossens CFMP Mersey Estuary CFMP
27		<p>Following the application of the Sequential Test, where proposed development is necessary in areas at 'residual risk' of fluvial flooding, an extreme flood event, or identified as susceptible to surface water flooding, it must be 'safe' in accordance with the NPPF³ including measures such as:</p> <ul style="list-style-type: none"> • Setting all 'more vulnerable' finished floor levels a minimum of 300mm above modelled 1000 year flood levels; • In certain circumstances some flexibility of the above may be acceptable, but will depend on further assessment of the vulnerability of the land use and the nature of the flooding, as well as other controls being in place such as warning and evacuation measures and the use of flood resilience and resistance; 	Vol. 1 Chapter 2 Vol. 1 Chapter 4 Figs B.3a to B.3d Figs B.6	NPPF Alt Crossens CFMP Mersey Estuary CFMP

³⁵ DEFRA/Environment Agency FD2320 Flood Risk Assessment for New Development, October 2005.

Recommended Guidance	Policy	Reference in the SFRA	Policy Support	
		<ul style="list-style-type: none"> • Safe refuge is available for all site users above modelled flood levels; • Where appropriate, emergency plans are in place to enable site users to safely evacuate the site and floodplain prior to the onset of flooding. The plan should include measures to ensure site users are aware of both the risk of flooding and actions to take; • ‘Essential infrastructure’ remains operational during flood conditions, including access where necessary. • Demonstrate emergency services can safely access the site, and site users, where necessary. 		
28		Individual breach assessments should be undertaken, in consultation with the Environment Agency, for sites identified at residual risk of flooding from a breach or failure of flood defence or canal infrastructure. Breach analysis should be carried out in accordance with FD2321 ¹⁹ .	Vol. 1 Chapter 2 Vol. 1 Chapter 4	
29		The functional floodplain should be safeguarded from new development, including removing or reducing obstructions, and provide environmental enhancement.	Vol. 1 Chapter 2 Vol. 1 Chapter 4 Table 6.1, Vol. 1 Chapter 6	Alt Crossens CFMP Mersey Estuary CFMP
30		It should be demonstrated that flood risk will not be increased to others as a result of new development, including level-for-level floodplain compensation, where necessary.	Vol. 1 Chapter 2 Vol. 1 Chapter 4	NPPF
Surface Water and Drainage				
31		KMBC should adopt a presumption against the hard-standing of domestic gardens and public open space to protect against Urban Creep.	Vol. 1 Chapter 4	
32		All major development should include appropriate SuDS techniques to manage surface water runoff from development based on the hierarchal approach in Part H of the Building Regulations (2000) ²⁵ , the SuDS Manual (CIRIA, 2007) ³⁶ and this SFRA. Where feasible development should aim to achieve Greenfield runoff rates, and as a minimum demonstrate a 50% reduction in runoff from the existing situation for Brownfield development. Drainage strategies in FRAs should demonstrate why a particular approach has been taken on this basis.	Vol. 1 Chapter 2 Vol. 1 Chapter 4	NPPF
33		All major development proposals should be designed to include ‘green roofs’ where feasible. Reference should be made to 2011 Green Roof Code ²⁴ when considering the design of green roofs.	Vol. 1 Chapter 2 Vol. 1 Chapter 4	
34		Developers should consult KMBC, the Environment Agency, and United Utilities at the earliest stage of the development process to establish the best SuDS solution for a new development.	Vol. 1 Chapter 2 Vol. 1 Chapter 4	NPPF

³⁶ CIRIA, 2007. The SuDS Manual, Report C697

Recommended Guidance	Policy	Reference in the SFRA	Policy Support	
35		Development layouts should consider the effects of 'exceedence' of the drainage system during the 1 in 100 year return period plus climate change event, including overland flow routes and storage of surface water in appropriate areas within the site layout.	Vol. 1 Chapter 2 Vol. 1 Chapter 4	NPPF

7 SFRA Maintenance and Management

7.1 Introduction

7.1.1 This chapter provides an introduction to the maintenance and management procedures that are required to ensure the SFRA remains up-to-date and continues to make use of the best available information. Implementing a maintenance and management procedure for the SFRA will assist KMBC to regularly review the technical data available and to commission technical updates where necessary.

7.1.2 Throughout this chapter, several key actions are recommended for KMBC in the implementation of a maintenance and management structure for the SFRA. These actions are highlighted in **blue bold text**.

7.2 Data Collection

7.2.1 The data sets used in the KMBC SFRA were supplied by:

- The Environment Agency
- Knowsley Metropolitan Borough Council
- United Utilities

7.2.2 Table 7-1 details the key data sets received from various organisations in order to develop the KMBC SFRA from July to December 2011. The SFRA is a living document and as such the contents of this table should be updated when the SFRA is revised and new data is incorporated. A record should be kept so that is possible to attribute the data used to inform flood risk at any moment in time throughout the plan period.

Table 7-1: Data Register

Data	Description	Source
OS Mapping, Mastermap	GIS layer identifying open space, water, roads and urban areas	KMBC
LiDAR	Digital topographical data for the catchment with a horizontal resolution of 2m and a vertical accuracy of +/- 0.15m	Environment Agency
Flood Zones, ABDs and Storage Areas	Fluvial flood zones (v201205)	Environment Agency
Flood Defence Asset data	GIS layer showing locations of Flood Defences including condition assessment	Environment Agency

Data	Description	Source
	and Standard of Protection(v201205)	
Knowsley Metropolitan Allocated sites	Potential Development Sites	KMBC
Emergency Plan	Knowsley Metropolitan Multi Agency Flood Plan & Merseyside Multi Agency Flood Response Plan	KMBC
Historic Flood data	Council Confirm Database	KMBC
	Historic Flood Map (v201205)	Environment Agency
Knowsley Level 1 SFRA	Knowsley Level 1 SFRA	KMBC
Childwall Brook 2008		Environment Agency (South Area)
Court Hey Brook 2009	Hydraulic model and flood risk mapping outputs	Environment Agency (South Area)
Ditton Brook 2008	Hydraulic model and flood risk mapping outputs	Environment Agency (South Area)
Logwood Mill Brook 2012	Hydraulic model and flood risk mapping outputs	Environment Agency (South Area)
Netherley and Halewood 2012	Hydraulic model and flood risk mapping outputs	Environment Agency (South Area)
Lower Alt Strategy Model	Hydraulic model and flood risk mapping outputs	Environment Agency (North Area)
Flood Map for Surface Water (FMfSW)	GIS Layer of Broad Scale modelling of areas potentially at risk of surface water flooding	Environment Agency
Knowsley Preliminary Flood Risk Assessment	An overview of all local sources of flood risk. Boroughs must review these PFRAs every 6 years.	KMBC
Reservoir Inundation Mapping	Potential reservoir breach extents	Environment Agency
Sewer assets and sewer/surface water flooding records	GIS layers of UU assets and historic sewer and water flooding records (WIRS)	United Utilities

7.2.3 It is recommended that during future iterations of the SFRA, the organisations in

Table 7 1 are contacted to ensure that the most up-to-date records are included in the SFRA.

7.3 Data Processing

7.3.1 The following processing was undertaken during the development of the SFRA:

7.3.2 Some additional model runs were undertaken for the 5% AEP design flood event using the existing EA hydraulic models in order to map the Functional Floodplain where this had not already been done. Where necessary model inflows for the 5% AEP event were estimated based on the flow estimates for other design events included in the EA model packages. No modifications were made to any of the hydraulic models apart from changing the inflow boundaries and re-running the models.

7.3.3 Where the EA had provided 2D hydraulic models, built using the Tuflow computational engine, these models were re-run to generate flood hazard results that can be used for a detailed assessment of the actual risk of fluvial flooding. The flood hazard is calculated by Tuflow during the model simulation as a function of the depth and velocity of flooding, taking account of the potential for debris in the flood waters.

7.3.4 The outputs of these additional model runs were processed to allow for mapping of flood outlines (and where possible depth, velocity and hazard) in Figures B3-A to B3-D.

7.4 Data Ownership

7.4.1 The datasets obtained for use in the SFRA have come from a number of sources, under licence agreement. These datasets cannot be passed to external parties without permission from the owner and that those who require the data should ensure that they possess the appropriate copyrights and access.

7.4.2 KMBC should be aware of the IPR they possess so that they only issue data that is contractually appropriate. Datasets produced during the SFRA are owned by KMBC and can be passed to external parties at their discretion. The key datasets are summarised in Table 7-2.

Table 7-2: Key Datasets

Data	Ownership	Licence Required	Contact
LiDAR	Environment Agency	Yes	Environment Agency

Data	Ownership	Licence Required	Contact
			(Geomatics Group)
Flood Zones and ABDs			Environment Agency
Flood Defences			
Hydraulic Models and Outputs			
Reservoir Inundation Mapping			
Flood Map for Surface Water (FMfSW)			
Historic Flood Map			
NFCDD			
Historic flood data (Confirm)	KMBC	No, may also be confidential	KMBC
OS Mapping	Ordnance Survey	Yes	
SFRA reports and Maps	KMBC	No	
Emergency Flood Plans	KMBC and Merseyside Resilience Forum	No	
Sewer Asset and Flood Risk	United Utilities	Yes, may also be confidential	United Utilities

7.4.3 It is recommended that information on all sources of flooding continues to be collected by KMBC periodically and in consultation with the data provider. The suggested frequency is at least on an annual basis depending on the availability of resources.

7.4.4 When more detailed or updated hydraulic modelling becomes available from the EA and other sources this information should be incorporated into the SFRA dataset. More detailed information should also be collated from FRAs carried out by developers at the local site scale. **Information from site level FRAs will be submitted to the Council and the Environment Agency as part of the planning process and this information should be logged as it may be useful in informing the LFRMS and future iterations of the SFRA.**

7.5 SFRA data management system

- 7.5.1 The data management strategy developed for the SFRA is designed to account for the likelihood that external parties will seek to make use of the information within the SFRA in preparing flood risk assessments and assessing the flood risk constraints at potential development sites. The SFRA is also a “live” document, and as such it is necessary to ensure at regular intervals in the future that the information within it remains valid.
- 7.5.2 To ensure that the SFRA remains ‘live’ it is important to nominate a Management Group with responsibility for monitoring, managing and maintaining the SFRA, as shown in Figure 7-1, overleaf. It is recommended that the monitoring of the SFRA is linked to the Borough’s Local Plan Monitoring Report. By following this process of information dissemination and review, the management team can ensure a consistent and up to date supply of strategic flood risk information to all levels of the planning process.

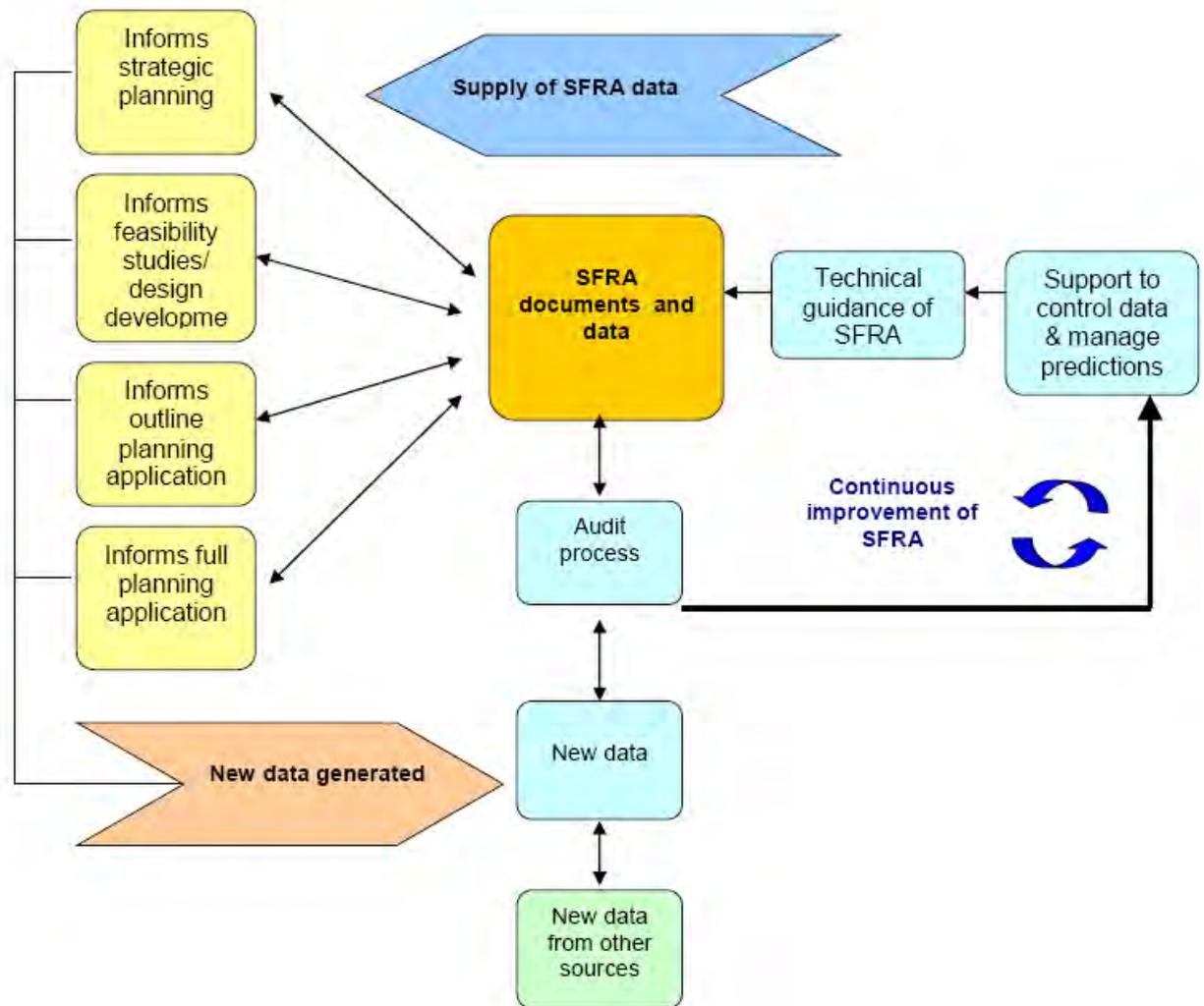


Figure 7-1: Conceptual SFRA management process

7.6 Monitoring the SFRA

7.6.1 It is in the interest of KMBC that the SFRA remains current and up to date.

7.6.2 Table 7-3 contains a list of datasets that are updated regularly along with the frequency of updates. Updating the SFRA would typically involve obtaining the latest map overlays for example rather than extensive new or updated modelling.

Table 7-3: Frequency of dataset renewal

Datasets	Owner	Frequency of update
Flood Zones	Environment Agency	Quarterly
Catchment Flood Management Plans	Environment Agency	Every five years
National Flood & Coastal Defence Database (NFCDD)	Environment Agency	Ongoing
Historic flood records (Historic Flood Map, Confirm, WIRS)	Environment Agency, United Utilities, KMBC	Ongoing
Surface Water Flood Maps	Environment Agency	When national modelling is updated

8 References

- Allitt, M & Tewkesbury, A (2009) Investigations into Urban Creep at 5 Cities
- British Waterways (2010) Hydraulic Design of Canal Works
- British Waterways Code of Practice for Waterways, April 2010.
- British Waterways, Waterways and Development Plans, February 2003.
- Chronology of British Hydrological Events. <http://www.trp.dundee.ac.uk/cbhe/welcome.htm>
- CIRIA (2004) 'Development and Flood Risk – Guidance for the Construction Industry' Report C624
- CIRIA (2006) Designing for Exceedence in Urban Drainage - Good Practice. Report C635
- CIRIA (2007) The SuDS Manual. Report C697
- Civil Contingencies Act 2004,
- Communities and Local Government (2007) Improving the Flood Performance of New Buildings: Flood resilient construction
- Communities and Local Government (2012) National Planning Policy Framework
- Communities and Local Government (2012) Technical Guidance to National Planning Policy Framework
- DEFRA (October 2006) 'FCDPAG3 Economic Appraisal Supplementary Note to Operating Authorities – Climate Change Impacts'
- DEFRA/Environment Agency FD2320 Flood Risk Assessment for New Development, October 2005.
- DEFRA/Environment Agency FD2321/TR1 Report Flood Risks to People, March 2006.
- Draft Flood and Water Management Bill, April 2009
- EC Floods Directive (2007/60/EC)
- Environment Agency (2008) Alt Crossens Catchment Flood Management Plan
- Environment Agency (2008) Mersey Estuary Catchment Flood Management Plan
- Environment Agency (2011) National Flood and Coastal Erosion Risk Management Strategy for England
- Environment Agency Flood Risk Matrix. <http://www.environment-agency.gov.uk/research/planning/93498.aspx>
- Environment Agency Flood Risk Standing Advice. <http://www.environment-agency.gov.uk/research/planning/82584.aspx/>

- Environment Agency's website. www.environment-agency.gov.uk/homeandleisure/default.aspx
- EU Water Framework Directive (2000/60/EC)
- Flood and Water Management Act, April 2010.
- Flood Risk Regulations (2009)
- Future water: the Government's water strategy for England, February 2008
- G. B. Wright, S. Arthur, G. Bowles, N. Bastien & D. Unwin. (2011). Urban creep in Scotland: stakeholder perceptions, quantification and cost implications of permeable solutions. *Water and Environment Journal*, Chartered Institute of Water and Environmental Management.
- HiFlows UK. www.environment-agency.gov.uk/hiflows
- Knowsley (2010) Multi-Agency Flood Plan (Part 2)
- Knowsley Council (2011) Preliminary Flood Risk Assessment for Knowsley
- Knowsley Council and Sefton Council (2009) *Strategic Flood Risk Assessment*, Atkins Limited
- Land Drainage Act, July 1991.
- Making space for water: Taking forward a new Government strategy for flood and coastal erosion risk management in England, March 2005.
- Merseyside Resilience Forum (2012) Community Risk Register V1.0.12.
- Merseyside Resilience Forum (2008) Multi-Agency Response Plan for Flooding in Merseyside
- North West River Basin Management Plan, December 2009.
- North West RSS Regional Flood Risk Appraisal, October 2008.
- North West RSS, September 2008.
- Part H Building Regulations, 2000.
- Planning Policy Statement 25: Development and Flood Risk – Practice Guide, December 2009.
- Planning Policy Statement 25: Development and Flood Risk, March 2010.
- Reservoirs Act, 1975.
- The Government's Response to Sir Michael Pitt's Review of the Summer 2007 Floods, December 2008
- The Green Roof Code, February 2011.

Town and Country Planning (General Development Procedure) (Amendment) (No. 2) (England) Order 2006

Water Industry Act, July 1991.

Appendix A Glossary

Term	Definition
ABD	Areas benefitting from defences. Those areas that are protected against flooding by flood defences with a standard of protection (SoP) equivalent to a 1% AEP flood event.
ABI	Association of British Insurers
Actual risk	<p>The flood risk posed from river, streams or tidal sources when taking into account the presence of defences.</p> <p>Where there are no defences then the Actual flood extent is unlikely to differ from the risk presented in the Environment Agency's Flood Zone Maps. Where defences exist and have been taken into account in detailed modelling then the extents will show the effect that those defences have on flood risk.</p> <p>It should be noted that the Actual risk assumes that the flood defences remain effective and fully operational during a flood event and no allowance is made for failure of the defences through breach. If a flood event overtops the defence then the extent reflects the volume of water that overtops the defence and makes no allowance for scour or erosion of the defence under such conditions.</p> <p>Actual risk covers scenarios with a 5%, 1% and 1% plus an allowance for climate change probability of occurring in any given year.</p>
AEP	Annual exceedance of probability: the annual chance of experiencing a flood with the corresponding flood magnitude, for example a 1% AEP flood is a flood with a flow magnitude that has a 1% chance of occurring in each and every year.
Areas Susceptible to Surface Water Flooding (AStSWF)	National scale surface water flood modelling published in 2009. Three bandings are indicated, showing areas that are Less, Intermediate and More Susceptible to surface water flooding.
BRE	Building Research Establishment
Breach or failure hazard	Hazards attributed to flooding caused by a breach or failure of flood defences or other infrastructure which is acting as a flood defence.
Building Regulations	Building Regulations promote standards that apply to most aspects of a buildings construction, energy efficiency and the covers drainage and waste disposal
BW	British Waterways. BW ceased to exist on 2 nd July 2012 and it has now been replaced by the Canal and River Trust.
CDA	Critical Drainage Area. Defined within the Town and Country Planning (General Development Procedure) (Amendment) (No. 2) (England) Order 2006 as "an area within Flood Zone 1 which has critical drainage problems and which has been notified... [to]...the local planning authority by the Environment Agency". In the context of this SFRA, the concept of a CDA applies to an area that contributes towards an area with surface water flooding issues.

Term	Definition
CFMP	Catchment Flood Management Plan: A high-level planning strategy through which the Environment Agency works with their key decision makers within a river catchment to identify and agree policies to secure the long-term sustainable management of flood risk.
CIRIA	Construction Industry Research and Information Association
Civil Contingencies Act 2004	The Civil Contingencies Act 2004, the bulk of which was enacted in 2005, imposed duties on local bodies to assess the risk of an emergency occurring and to maintain plans for the purposes of responding to emergencies. Emergency includes acts that would have engaged previous civil defence legislation, terrorism and events which threaten serious damage to human welfare or to the environment.
CLG	Communities and Local Government: The Government department responsible for the National Planning Policy Framework (NPPF) ³ and the Technical Guidance to the National Planning Policy Framework ⁴
Climate Change	Long term variations in global temperature and weather patterns caused by natural and human actions.
Consequence	Impact that the flood event would cause if it occurred
Culvert	A channel or pipe that carries water below the level of the ground
DEFRA	Department for Environment, Food and Rural Affairs: The Government department responsible for environmental protection, agriculture, food production and food standards as well as fisheries and rural communities.
Developable Area	The area or proportion of the site that is developable for a specific type of development/vulnerability class without application of the exception test. The areas defined in this SFRA are as follows: <ul style="list-style-type: none"> • Very High Risk Areas – Water Compatible / Essential Infrastructure only • High Risk Areas – Less Vulnerable development • Moderate Risk Areas – More Vulnerable development • Low Risk Areas – All types of development
DG5 Register	A water-company held register of properties that have experienced sewer flooding due to hydraulic overload, or properties which are 'at risk' of sewer flooding more frequently than once in 20 years.
Drift Geology	The name for all material of glacial origin found anywhere on land or at sea. Typically refers to deposits made up to 2.6 million years ago.
EA	Environment Agency: A non-departmental Agency reporting to DEFRA charged with protecting or enhancing the Environment and managing flood risk and pollution in England.

Term	Definition
Exception Test	The Exception Test should be applied following the application of the Sequential Test. In order to pass the exception test, it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, is on developable land, the development is safe and will not increase flood risk elsewhere.
Flood Defence	Flood walls and embankments intended to protect an area against flooding.
Flood Map for Surface Water (FMfSW)	National scale surface water flood modelling published in 2009. Two bandings are provided, 'Surface Water Flooding' and 'Deeper Surface Water Flooding', which indicate surface water flooding greater than 0.1m and greater than 0.3m respectively. There are outputs available for events with a 1 in 30 and 1 in 200 chance of occurring in any given year.
Flood risk	A combination of two components: the chance (or probability) of a particular flood event and the impact (or consequence) that the event would cause if it occurred.
Flood risk management	Flood risk management can reduce the probability of occurrence through the management of land, river systems and flood defences, and reduce the impact through influencing development in flood risk areas, flood warning and emergency response.
Flood Risk Vulnerability	Classifications presented within the Technical Guidance to the National Planning Policy Framework, which indicates the vulnerability of a specific land-use to flood risk. For example houses and hospitals are less vulnerable to flooding than shops and industry
Flood Zone Maps	Maps produced by the Environment Agency depicting the extent of flood zones.
Flood Zones	This refers to the Flood Zones in accordance with Table 1 of the Technical Guidance to the National Planning Policy Framework ³⁷ . Flood Zone 1 is land with a probability of flooding on average once in over 1000 years. Flood Zone 2 is land with a probability of flooding on average between once in 100 and once in 1000 years. Flood Zone 3 is land with a probability of flooding on average more than once in 100 years. Flood Zone 3b is a functional floodplain. For the purpose of the SFRA, where the 'actual risk' is referred to this reflects the vulnerability of land to flooding taking into account the presence of flood defences.
Floodplain	Area of land that borders a watercourse, an estuary or the sea, over which water flows in time of flood, or would flow but for the presence of flood defences where they exist.

³⁷ National Planning Policy Framework, March 2012.

Term	Definition
Floods and Water Management Act (FWMA) ¹⁰	An Act of Parliament which forms part of the UK Government's response to Sir Michael Pitt's Report on the Summer 2007 floods. The Act takes forward some of the proposals in three previous strategy documents published by the UK Government – Future Water ³⁸ , Making Space for Water ³¹ and the UK Government's response to the Sir Michael Pitt's Review of the Summer 2007 floods ³⁹ . The Act also takes forward parts of the draft Flood and Water Management Bill ⁴⁰ and takes into account pre-legislative scrutiny of the draft Bill by the Environment, Food and Rural Affairs Committee. The Act was passed in 2010 and is currently being enacted.
Fluvial	Relating to a watercourse (rivers or streams)
FRA	Flood Risk Assessment: A study to assess the risk of flooding caused by development both now and in the future. It includes flooding to other areas in addition to flooding on site.
Freeboard	The height of the top of a bank, floodwall or other flood defence structure, above the design water level (normally the water level that would occur disregarding any effects from wave action).
FRR	Flood Risk Regulations ⁴¹ : Transposition of the EU Floods Directive ⁴² into UK law. The EU Floods Directive is a piece of European Community (EC) legislation to specifically address flood risk by prescribing a common framework for its measurement and management.
FRSA	Flood Risk Standing Advice. The Environment Agency's website providing development and flood risk advice for Local Planning Authorities, applicants and agents.
FZM	Flood Zone Map. The term used to refer to the Environment Agency's maps that present the currently defined Flood Zones.
GEM	The Groundwater Emergence Maps (GEMs) identify those parts of England where, in exceptionally wet winters, groundwater levels could be expected to be at or close to the ground surface. Where possible these maps have been calibrated on observations made in the winter of 2000-01. Where no flooding was reported, or information was not made available, the maps indicated estimated areas based on anticipated groundwater levels using relevant aquifer properties or river baseflow indexes.
Groundwater	Water stored underground in areas of permeable rocks, known as aquifers. Consistently high levels of groundwater can lead to groundwater flooding.

³⁸ Future water: the Government's water strategy for England, February 2008

³⁹ The Government's Response to Sir Michael Pitt's Review of the Summer 2007 Floods, December 2008

⁴⁰ Draft Flood and Water Management Bill, April 2009

⁴¹ Flood Risk Regulations (2009)

⁴² EC Floods Directive (2007/60/EC)

Term	Definition
Groundwater Rebound	Groundwater rebound is the term given to local or regional groundwater levels that rise back to natural levels as a result of the cessation of activities that had artificially lowered the groundwater level, such as groundwater pumping associated with mining or abstraction of water for use in industrial processes. Because groundwater levels have often been artificially controlled for long periods of time there is risk to vulnerable sub-surface infrastructure built in the intervening time period.
HEC-RAS	Hydraulic modelling software (River Analysis System) developed by the United States Army Hydraulic Engineering Corps (HEC) to simulate the hydraulics of waterways in 1D
ISIS	Hydraulic modelling software developed by Halcrow to simulate the hydraulics of waterways in 1D and 2D.
JFLOW	Hydraulic modelling software developed by JBA to simulate the hydraulics of waterways in 2D.
KMBC	Knowsley Metropolitan Borough Council
LDD	Local Development Documents: Documents describing a Local Planning Authority's strategy for development and use of land within their area of authority. These include Local Plans, Supplementary Planning documents, and Neighbourhood Plans
LFRMS	Local Flood Risk Management Strategy. Under the Flood & Water Management Act 2010 ¹⁰ , a Lead Local Flood Authority (LLFA) must produce a strategy for managing local flood risk from surface run off, ordinary water courses and ground water.
LiDAR	Light Detection and Ranging, a technique to measure ground and building levels remotely from the air, LiDAR data is used to develop DTMs and DEMs (see definitions above).
LLFA	Lead Local Flood Authority: Local Authority responsible for taking the lead on local flood risk management. The duties of LLFAs are set out in the Floods and Water Management Act ¹⁰ .
Local Plan	The plan for the future development of the local area drawn up by the local planning authority in consultation with the community.
Local Sources of Flooding	The flood risk posed from ordinary watercourses, surface water, groundwater, canals and small reservoirs. Any source of flooding other than main rivers, the sea and large reservoirs.
LPA	Local Planning Authority
MAFP	Multi-Agency Flood Plan. An emergency plan focussed specifically on the complex issues associated with flooding that can be prepared by a Local Resilience Forum and/or a Local Planning Authority.

Term	Definition
Main River	A statutory type of watercourse in England and Wales which are usually larger streams and rivers, but may also include some smaller watercourses. They must be defined as a watercourse on a main river map. It can include any structure or appliance for controlling or regulating the flow of water in, into or out of a main river. The Environment Agency's powers to carry out flood defence works apply to main rivers only.
NFCDD	National Flood and Coastal Defence Database: Mapping data showing the areas at risk of flooding and data about the defences themselves (their type, location and condition) and the areas that benefit from those defences.
NGR	National Grid Reference
NPPF	National Planning Policy Framework ³ : the document and its supporting Technical Guidance ⁴ that sets out the Government's planning policies for England and how these are expected to be applied. It provides a framework within which local and neighbourhood plans can be produced to reflect local needs and priorities.
Ordinary Watercourse	All watercourses that are not designated main river, and which are the responsibility of Local Authorities or, where they exist, IDBs are termed Ordinary Watercourses.
PAR	Preliminary Appraisal Report. The reporting element of the Preliminary Flood Risk Assessment (PFRA) process
PFRA	Preliminary Flood Risk Assessment: A statutory requirement of the Flood Risk Regulations ⁴¹ , which implement the requirements of the European Floods Directive ⁴² . The Floods Directive required PFRAs to be published by 22 December 2011.
Policy Unit	A defined area in which the Environment Agency's CFMP policies are applied. Knowsley forms a Policy Area within the Mersey Estuary CFMP and falls within the Liverpool Policy Unit of the Alt Crossens CFMP.
PPS25	Planning Policy Statement 25: <i>Development and Flood Risk</i> (December 2006) ² . Now replaced, along with its Practice Guide ⁴³ , by the National Planning Policy Framework (March 2012)
Probability of Consequence	The probability of a flood event being met or exceeded in any one year. For example, a probability of 1 in 100 corresponds to a 1 per cent or 100:1 chance of an event occurring in any one year.
RBMP	River Basin Management Plan. A strategic document that sets out measures to protect and improve the water environment. They have been developed in consultation with organisations and individuals and they identify the main issues for the water environment and the actions that are needed to deal with them.
Receptor	A property, business or land-use that is at risk from flooding.

⁴³ Planning Policy Statement 25: Development and Flood Risk – Practice Guide, December 2009.

Term	Definition
Residual risk	Flood risks resulting from an event more severe than for which particular flood defences have been designed to provide protection.
RFRA	The North West Regional Spatial Strategy Regional Flood Risk Appraisal ¹⁶ developed by 4NW to support the RSS.
RPB	Regional Planning Body
RSS	Regional Spatial Strategy: The Regional Planning Document that provides a broad development strategy for the region for a fifteen to twenty year period. In the North West the RSS is referred to as the North West of England Plan – Regional Spatial Strategy to 2021 ³² . The Government has expressed its intent to revoke Regional Spatial Strategies.
SAB	SuDS Approval Body. A body that will be set up on the commencement of the National Standards for Sustainable Drainage (likely to be the lead local flood authority) that will be responsible for approving, adopting and maintaining drainage plans and SuDS schemes that meet the National Standards for sustainable drainage systems serving two or more properties.
Sequential risk-based assessment	Priority in allocating or permitting sites for development, in descending order to the Flood Zones set out in Table 1 of the Technical Guidance to the National Planning Policy Framework ⁴ , including the sub divisions in Zone 3. Those responsible for land development plans or deciding applications for development would be expected to demonstrate that there are no reasonable options available in a lower- risk category.
Sequential Test	A test to determine if other sites are available in areas with a lower probability of flooding that would be appropriate to the type of development or land use proposed.
Sewer flooding	Sewer flooding occurs when surface water or foul sewage escapes from the sewerage system due to either hydraulic inadequacy or other causes (blockage, collapse or equipment failure).
SFRA	Strategic Flood Risk Assessment: There are 2 levels of an SFRA. Level 1 is a tool used by planning authorities to assess flood risk for spatial planning, producing development briefs, setting constraints, informing sustainability appraisals, identifying locations of emergency planning measures and requirements for flood risk assessments. It provides information on flood risk within the borough and guidance on application of the Sequential Test and Flood Risk Assessments for development planning. A Level 2 SFRA (this report) is a more detailed assessment produced where the Exception Test is required for a potential development site.

Term	Definition
SIRS	Sewer Incident Reporting System. A now superseded database of historical incidents associated with United Utilities sewer network. Replaced in 2008 by the Water Incident Reporting System (WIRS).
SMBC	Sefton Metropolitan Borough Council
Solid Geology	The bedrock geology underlying soil or drift geology.
SoP	Standard of Protection: The actual or design standard of protection afforded by a flood defence, whether formal or informal. Usually expressed as an Annual Exceedance Probability.
SuDS	Sustainable Drainage Systems: Control measures designed to drain surface water in a more sustainable manner rather than conventional techniques such as drainage pipes / sewers.
Surface water	Any body of water that is not groundwater (for example rivers, estuaries, ponds etc) as well as temporary waters resulting from flooding, run-off etc.
SWMP	Surface Water Management Plan
TUFLOW	Hydraulic modelling software developed by WBM to simulate the hydraulics of waterways in 2D.
WFD	The Water Framework Directive (2000/60/EC) ³⁴ came into force in 2000. It was transposed into UK law in 2003 and it establishes a strategic framework for the management of the water environment with the aim of enhancing aquatic ecosystems, promoting the sustainable use of water and reducing water pollution.
Windfall Sites	Sites which become available for development unexpectedly and are therefore not included as allocated land in a planning authority's development plan
WIRS	Water Incident Reporting System. A database of incidents associated with United Utilities sewer network. Replaced the Sewer incident Reporting System (SIRS) in 2008.

Appendix B Principal Culverted Watercourses

Watercourse	Culvert ID	Asset Reference	Maintainer	Asset Description	Grid Reference	Condition	Design Standard	Opportunities for Deculverting
Knowsley Brook	1	01214KNOW0101B11	Private	Culvert, 1.8m x 2.15m Rectangular Concrete with Short Section of Steel Grill Soffit @ 26m upstream of Outlet	SJ4273996652	3	100	Perhaps, if redeveloped
		01214KNOW0101B12	Private	Culvert, 1.8m x 2.15m Rectangular Concrete with Short Section of Steel Grill Soffit	SJ4287496671	3	100	Perhaps, if redeveloped
		01214KNOW0101B13	Private	Culvert pipe, 2m Circular Concrete	SJ4287296785	3	100	Perhaps, if redeveloped
		01214KNOW0101B14	Private	Culvert pipe, 2m Circular Concrete	SJ4306696805	3	100	Perhaps, if redeveloped
		01214KNOW0101B15	Private	Culvert pipe, 2m Circular Concrete	SJ4327596818	3	100	Perhaps, if redeveloped
		01214KNOW0101B16	Private	Culvert pipe, 2m Circular Concrete	SJ4346196828	3	100	Perhaps, if redeveloped
Knowsley Brook	2	01214KNOW0101B10	Local Authority	Culvert, 2.7m x 2.3m Arched Masonry	SJ4196196627	3	100	No
Knowsley Brook	3	01214KNOW0101B08	Local Authority	Culvert, 2.1m x 2.9m Rectangular Concrete	SJ4183996634	3	100	No
		01214KNOW0101B09	Local Authority	Culvert, 2.1m x 2.9m Rectangular Concrete	SJ4183996634	3	100	No

Watercourse	Culvert ID	Asset Reference	Maintainer	Asset Description	Grid Reference	Condition	Design Standard	Opportunities for Deculverting
Knowsley Brook	4	01214KNOW0101B06	Local Authority	Culvert, 2.6m x 4m Rectangular Concrete	SJ4159796746	3	100	No
		01214KNOW0101B07	Local Authority	Culvert, 2.6m x 3.5m Rectangular Masonry with Concrete Soffit	SJ4159796746	3	100	No
Knowsley Brook	5	01214KNOW0101B04	Private	Culvert, 2.1m x 2.9m Rectangular Concrete	SJ4115996980	3	100	No
		01214KNOW0101B05	Private	Culvert, 2.1m x 2.9m Rectangular Concrete	SJ4107096926	3	100	No
Knowsley Brook	6	01214KNOW0101B17	Private	Culvert pipe, 1.2m Circular Concrete	SJ4356396918	3	100	No
		01214KNOW0101B18	Private	Culvert pipe, 1.5m Circular Concrete	SJ4363396991	3	100	Yes
		01214KNOW0101B19	Private	Culvert pipe, 1.5m Circular Concrete	SJ4363396991	3	100	Yes
Mill Brook	7	01214MILK0101B11	Local Authority	Culvert, 1.25m x 3.5m Rectangular Concrete	SJ4349396038	3	100	No
Mill Brook	8	01214MILK0101B10	Local Authority	Culvert, 0.65m x 1.85m Rectangular Concrete. Height changes to 0.72m	SJ4346496085	3	100	No
Mill Brook	9	01214MILK0101B01	Local Authority	Culvert, 1m x 3m Rectangular Concrete	SJ4275096405	3	100	No
		01214MILK0101B02	Local Authority	Culvert pipe, 1.6m Circular Concrete	SJ4277896390	3	100	No
		01214MILK0101B03	Local Authority	Culvert pipe, 1.6m Circular Concrete	SJ4283396377	3	100	No

Watercourse	Culvert ID	Asset Reference	Maintainer	Asset Description	Grid Reference	Condition	Design Standard	Opportunities for Deculverting
		01214MILK0101B04	Local Authority	Culvert pipe, 1.6m Circular Concrete	SJ4283396377	3	100	No
		01214MILK0101B05	Local Authority	Culvert pipe, 1.6m Circular Concrete	SJ4287096381	3	100	No
		01214MILK0101B06	Local Authority	Culvert pipe, 1.6m Circular Concrete	SJ4292496365	3	100	No
		01214MILK0101B07	Local Authority	Culvert pipe, 1.6m Circular Concrete	SJ4302096322	3	100	No
		01214MILK0101B08	Local Authority	Culvert pipe, 1.6m Circular Concrete	SJ4310496282	3	100	No
		01214MILK0101B09	Local Authority	Culvert pipe, 1.6m Circular Concrete	SJ4319396243	3	100	No
Ormskirk Road	10	01214ORMS0201B02	Local Authority	Culvert pipe, 0.3m Circular Vitrified Clay (CCTV)	SJ4408395317	3	50	Not recommended
Croxteth Brook	11	01214CROX0101B05	Local Authority	Culvert	SJ4089796628	3	100	No
Prescot Brook	12	01315PRES0103B11	Private	Culverted access crossing.	SJ4570893367	4	5	No
Prescot Brook	13	01315PRES0101B05	Local Authority	Culvert.	SJ4572392838	3	5	No
Prescot Brook	14	01315PRES0101B01	Private	Culvert	SJ4591392672	3	5	Potentially but would affect playing field
Logwood brook	15	01315LOGW0101B37	Private	Culvert	SJ4576991013	3	5	No
Logwood brook	16	01315LOGW0101B24	Local Authority	Twin concrete box culverted road crossing.	SJ4580890955	3	5	No
Logwood brook	17	01315LOGW0101B23	Private	Precast concrete pipe culvert.	SJ4582690834	3	5	No
Logwood brook	18	01315LOGW0101B18	Local Authority	Poured concrete box culverted road crossing	SJ4606489739	3	5	No

Watercourse	Culvert ID	Asset Reference	Maintainer	Asset Description	Grid Reference	Condition	Design Standard	Opportunities for Deculverting
Logwood brook	19	01315LOGW0101B17	Private	Concrete culverted road crossing	SJ4629789591	3	5	No
Logwood brook	20	01315LOGW0101B16	Local Authority	Concrete culverted road crossing.	SJ4642489547	3	5	No
Logwood brook	21	01315LOGW0101B13	Local Authority	Culverted road crossing.	SJ4662789203	3	5	No
Logwood brook	22	01315LOGW0101B15	Private	Poured concrete culvert / roadbridge.	SJ4656989393	3	5	No
Logwood brook	23	01315LOGW0101B40	Private	Concrete culverted road crossing. (Highways Agency)	SJ4648088780	3	5	No
Whiston Brook	24	01315WHIS0101B02	Private	Concrete pipe culvert. Highways Agency.	SJ4782689741	4	5	No
Fox's Bank Brook	25	01315FOX0101B09	Private	Armco culvert under "quarry" area (Non main river line)	SJ4706689176	5	5	Yes
Fox's Bank Brook	26	01315FOX0101B06	Private	Precast concrete culvert.	SJ4705189154	9	5	Yes
Fox's Bank Brook	27	01315FOX0101B02	Local Authority	Precast concrete pipe culvert.	SJ4693389077	3	5	No
Dog Clog Brook	28	01315DOG10101B20	Private	Precast concrete culvert	SJ4961488722	4	5	Yes
Dog Clog Brook	29	01315DOG10101B16	Private	Culvert.	SJ4928288518	3	5	No
Dog Clog Brook	30	01315DOG10101B13	Local Authority	Culverted road crossing.	SJ4854188331	3	5	No
Dog Clog Brook	31	01315DOG20101B01	Environment Agency	PVC pipe culvert	SJ4735687777	3	100	Yes
		01315DOG30101B01	Environment Agency	Twin steel/iron pipe culvert.	SJ4716087764	3	100	Yes

Watercourse	Culvert ID	Asset Reference	Maintainer	Asset Description	Grid Reference	Condition	Design Standard	Opportunities for Deculverting
				Pumping station delivery pipes.				
		01315DOG30101B02	Environment Agency	Precast concrete pipe culvert	SJ4716787769	3	100	Yes
		01315DOG40101B01	Environment Agency	Bitumenised steel pipe culvert.	SJ4717087770	4	100	Yes
		01315DOG40101B02	Private	Bitumenised steel pipe culvert.	SJ4735787778	4	5	Yes
Dog Clog Brook	32	01315DOG30101B03	Private	Precast concrete pipe culvert	SJ4720687838	4	5	Yes
Dog Clog Brook	33	01315DOG10101B03	Local Authority	Concrete box culvert.	SJ4686887887	3	5	No
Alder Brook	34	01315ALDB0101B04	Local Authority	Armco culvert	SJ4947687795	4	5	No
Brunt Boggart	35	01315BRNT0101B06	Private	Precast concrete pipe culvert.	SJ4678188229	9	5	Yes but would affect field
Brunt Boggart	36	01315BRNT0101B04	Local Authority	Precast concrete box culvert	SJ4668888216	4	5	No
Brunt Boggart	37	01315BRNT0101B01	Private	Precast concrete pipe culvert	SJ4658387972	4	5	Yes but would affect field
Netherley Brook	38	01315NETH0101B12	Private	Precast concrete culvert.	SJ4466189632	3	5	Not recommended
Netherley Brook	39	01315NETH0101B11	Private	Precast concrete pipe culverted road crossing. (Highways Agency)	SJ4460489594	3	5	No
Netherley Brook	40	01315NETH0101B06	Local Authority	Concrete box culverted road crossing.	SJ4465688340	4	5	No
Huyton Brook	41	01315HUY10101B05	Private	Poured concrete roadbridge / culvert.	SJ4357989713	3	5	Northern half not below M62

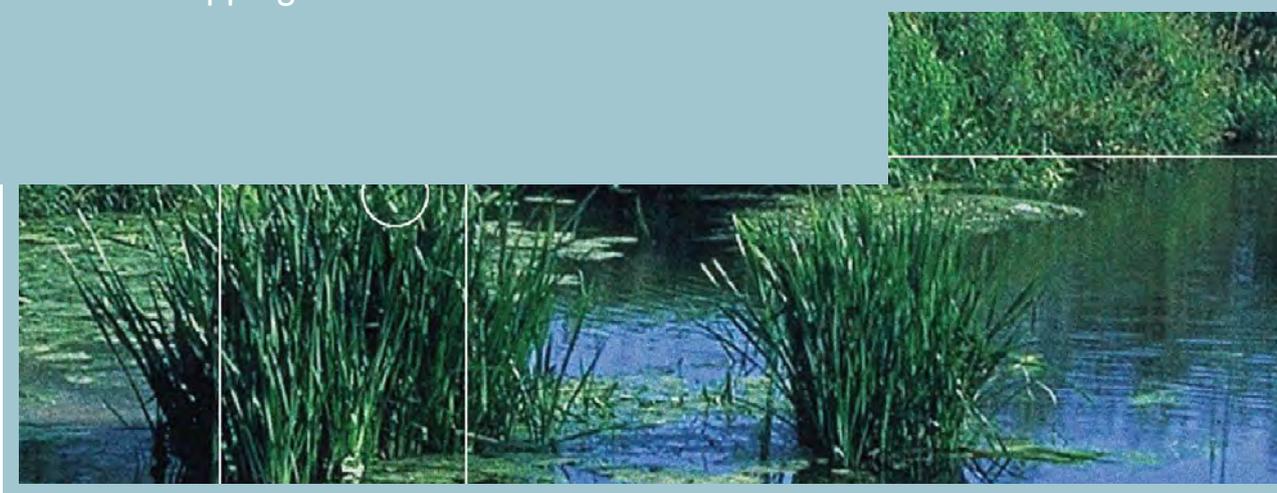
Watercourse	Culvert ID	Asset Reference	Maintainer	Asset Description	Grid Reference	Condition	Design Standard	Opportunities for Deculverting
Childwall Brook	42	01315CHIL0101B01	Private	Poured concrete box culvert - required spatial change to match manholes in AIMS	SJ4465488339	3	5	Potentially within Sports Ground and alongside Sarum road depending upon alignment relative to road
Stonehough Brook	43	01315STOB0101B06	Local Authority	Culvert	SJ4639687502	3	5	Potentially the eastern half of the culvert
Stonehough Brook	44	01315STOB0101B11	Private	Precast concrete pipe culverted farm crossing	SJ4632987509	5	5	Potentially the eastern end of the culvert
Halewood Brook	45	01315HAL10101B10	Private	Culverted farm crossing.	SJ4510587229	4	5	Yes but would affect field
Halewood Brook	46	01315HAL10101B15	Local Authority	Culverted road crossing.	SJ4554786650	3	5	No
Woodend Brook	47	01315WEND0101B08	Private	Culvert.	SJ4491886395	3	5	Potentially in parts
Woodend Brook	48	01315WEND0101B03	Private	Culvert.	SJ4528286557	3	5	Potentially
Spring Brook	49	01315SPRG0101B07	Private	Masonry culvert.	SJ4712686101	3	5	Potentially south eastern half
Spring Brook	50	01315SPRG0101B06	Private	Precast concrete culverted farm crossing	SJ4731285950	9	5	No
Spring Brook	51	01315SPRG0101B09	Local Authority	Culverted road crossing.	SJ4749085764	4	5	No
Spring Brook	52	01315SPRG0101B08	Private	Culvert.	SJ4771785238	5	5	No

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Knowsley Metropolitan Borough Council
Level 2 Strategic Flood Risk Assessment

Volume 2 – Mapping and Site Assessments



CAPITA SYMONDS

October 2012

Quality Management

DOCUMENT INFORMATION

Title:	Knowsley Metropolitan Borough Council Level 2 Strategic Flood Risk Assessment – Volume 2
Owner:	Arthur Duffy
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Status:	Final
Project Number:	CS056421
File Name:	S:\ZWET\Sheffield Based Jobs\CS056421_KnowsleySFRA\Reports and Outputs\Site Assessments\Final - Reviewed and Amended

REVISION HISTORY

Summary of Changes	Completed By	Date of Issue	Version
First Draft	LT / PR	21/06/2012	1.0
Second Draft	LT / PR	11/08/2012	2.0
Third Draft	LT / PR	07/09/2012	3.0
Final	LT / PR	19/09/2012	4.0
Final amendments	PR	10/10/2012	5.0

AUTHOR

Name	Organisation and Role
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Philip Raynor	Associate Director, Capita Symonds

APPROVALS

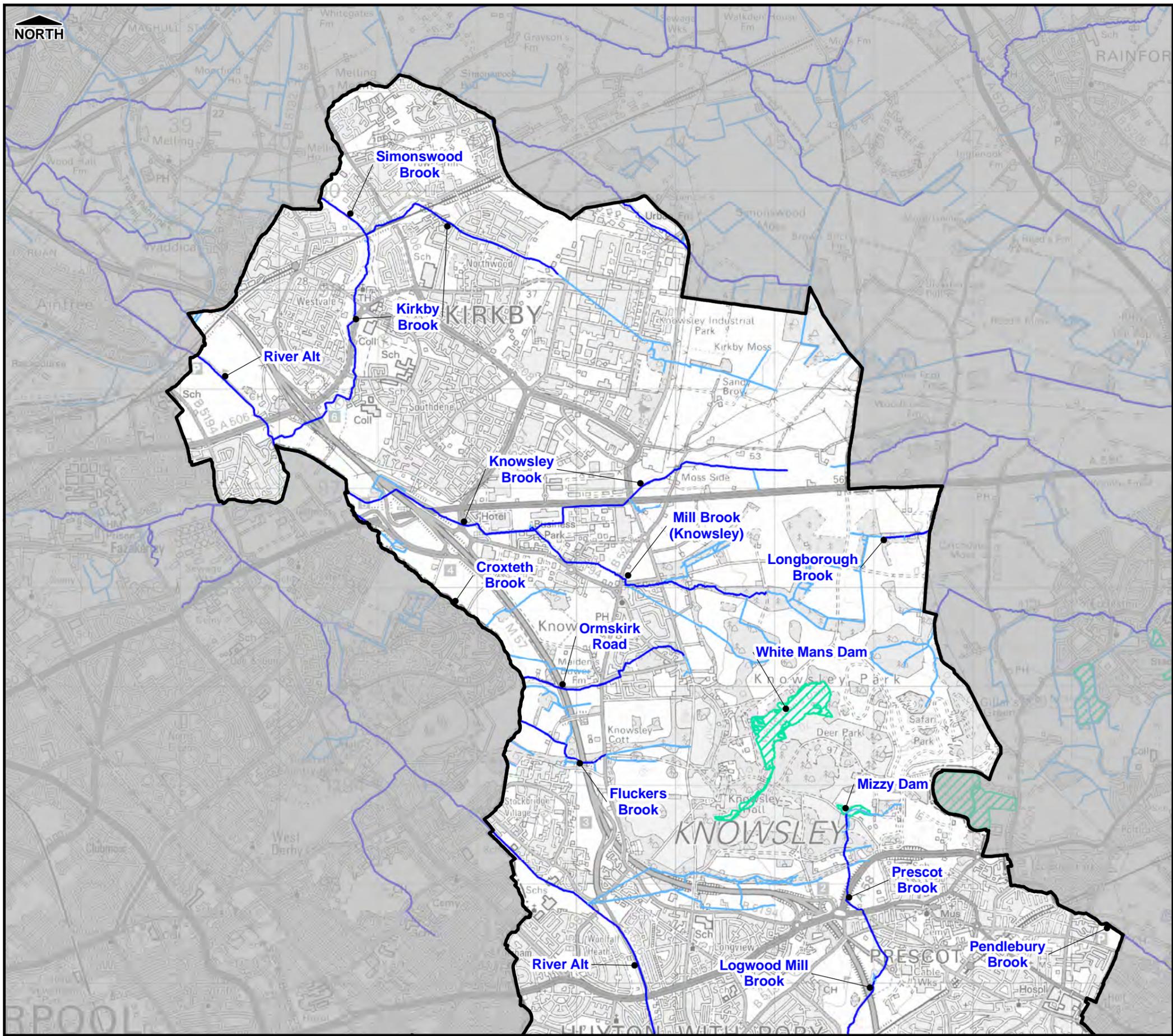
Name	Title	Signature	Date
Philip Raynor	Associate Director, Capita Symonds		30/10/2012
Ruth Goodall	Director, Capita Symonds		

DISTRIBUTION

Name	Organisation and Role
Jonathan Clarke	Policy Manager (Places and Neighbourhoods)
Arthur Duffy	LDF Principal Planner – Places and Neighbourhoods
Frank Broom	Principal Engineer, Drainage – Highways Asset Management

RELATED DOCUMENTS

Document Title	Author	Date of Issue	Version
Knowsley Metropolitan Borough Council Level 2 Strategic Flood Risk Assessment – Volume 1	LT/PR	30/10/2012	Final (V6.0)



Legend

-  Borough Administrative Boundary
-  Main River
-  Ordinary Watercourse
-  Lakes/Reservoirs

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RISK ASSESSMENT**

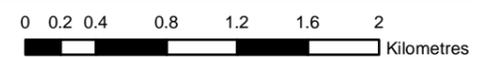
Figure B1-1-1
Catchment Overview

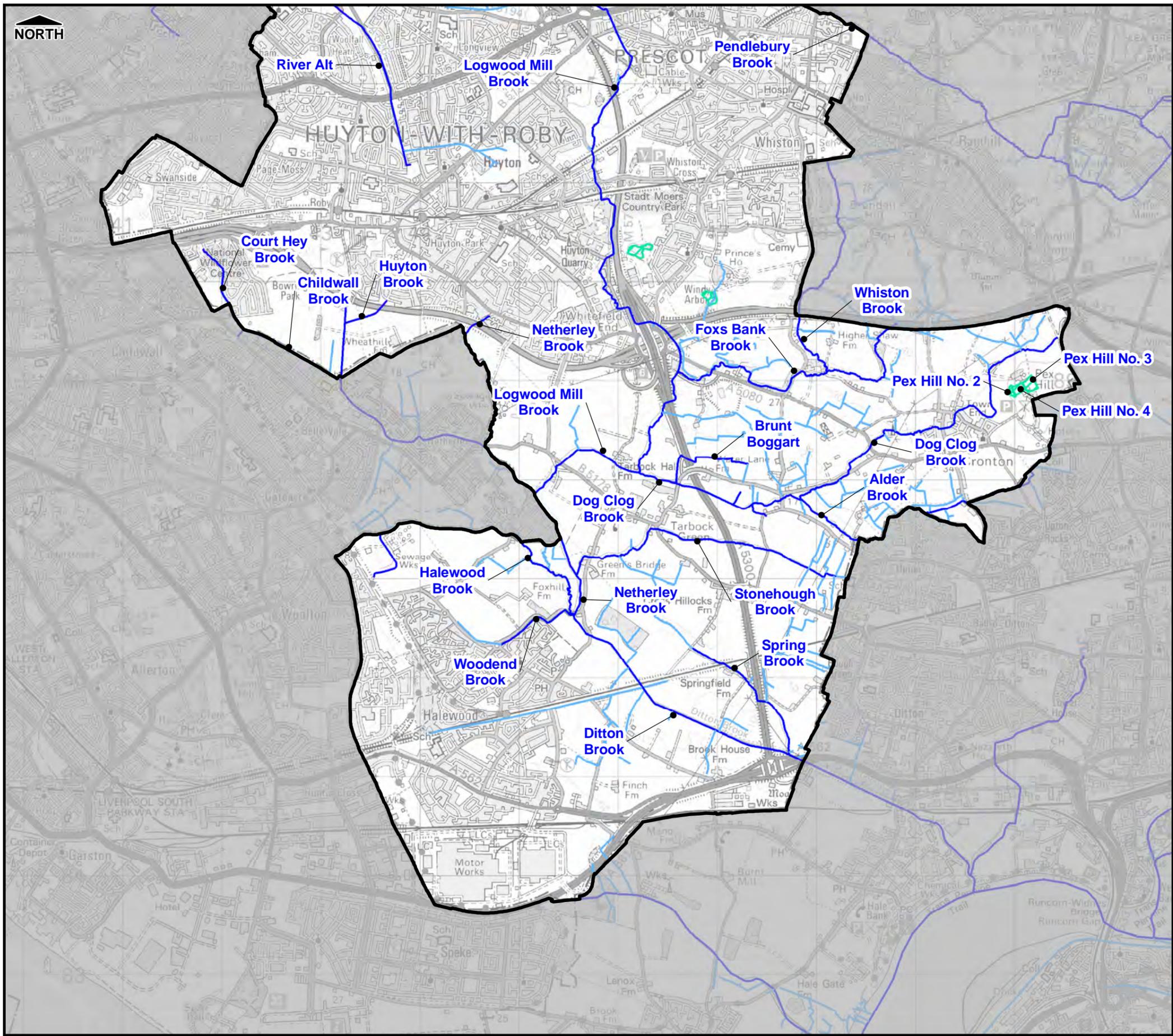


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NORTH

Legend

-  Borough Administrative Boundary
-  Main River
-  Ordinary Watercourse
-  Lakes/Reservoirs

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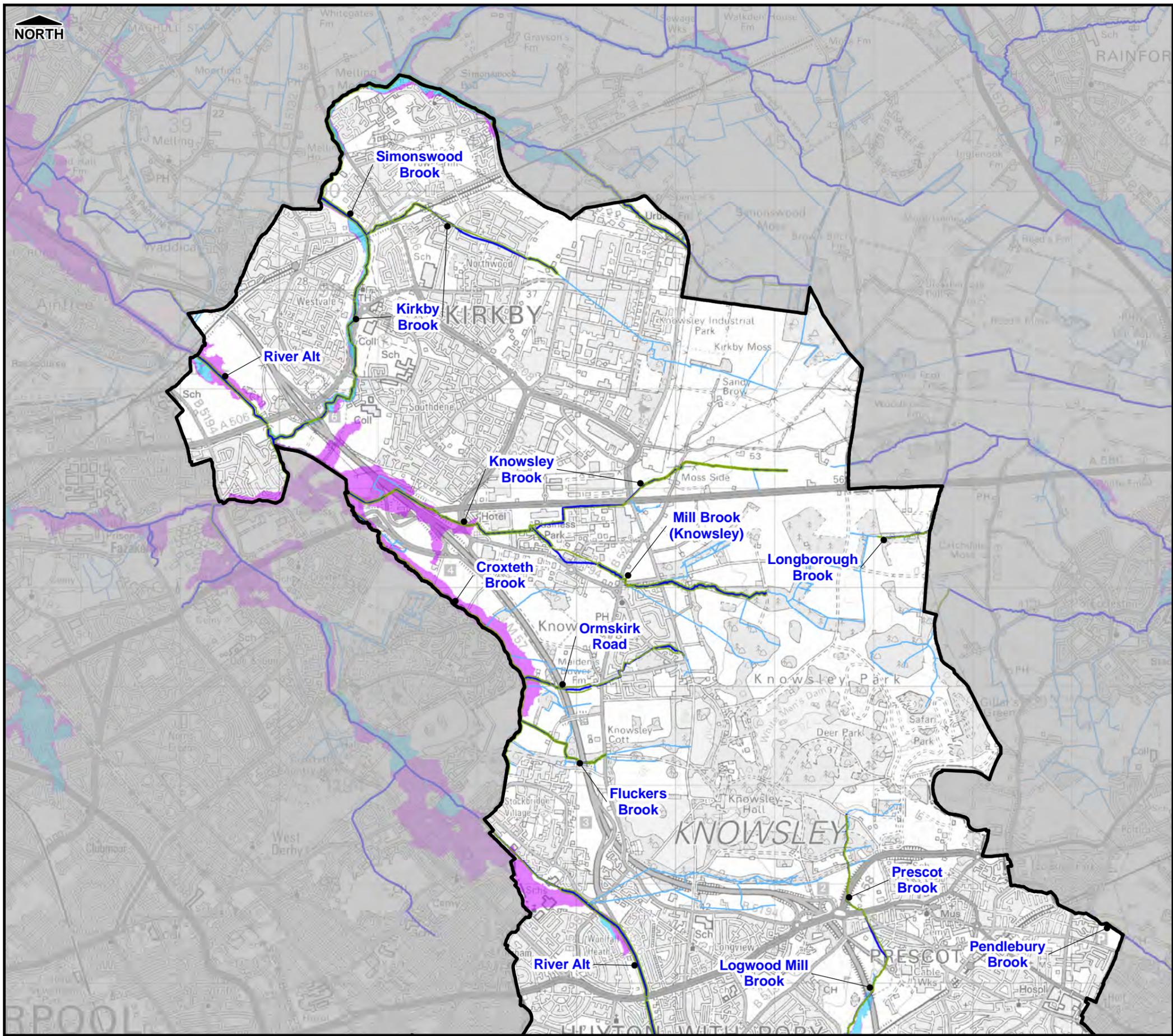
Figure B1-1-2
Catchment Overview



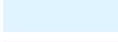
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Legend

-  Borough Administrative Boundary
-  Defences
-  Main River
-  Ordinary Watercourse
-  Flood Zone 2 Fluvial and Tidal
-  Flood Zone 2 Tidal
-  Flood Zone 3a Fluvial and Tidal
-  Flood Zone 3a Tidal
-  Flood Zone 2 Fluvial
-  Flood Zone 3a Fluvial

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**KNOWSLEY METROPOLITAN
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RISK ASSESSMENT**

Figure B2-1
Environment Agency Flood Zones

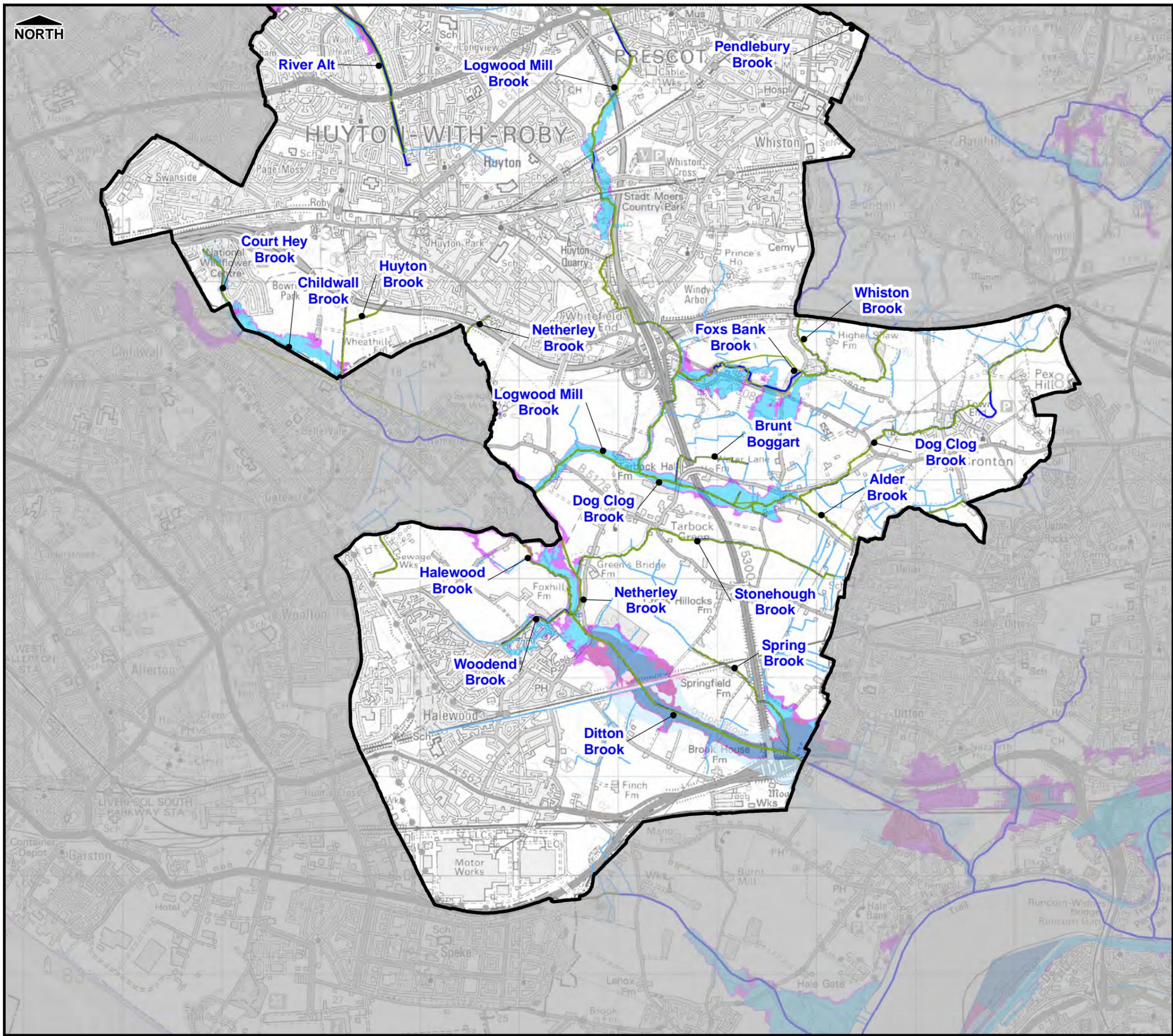


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Legend

-  Borough Administrative Boundary
-  Defences
-  Main River
-  Ordinary Watercourse
-  Flood Zone 2 Fluvial and Tidal
-  Flood Zone 2 Tidal
-  Flood Zone 3a Fluvial and Tidal
-  Flood Zone 3a Tidal
-  Flood Zone 2 Fluvial
-  Flood Zone 3a Fluvial

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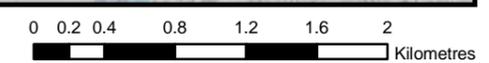
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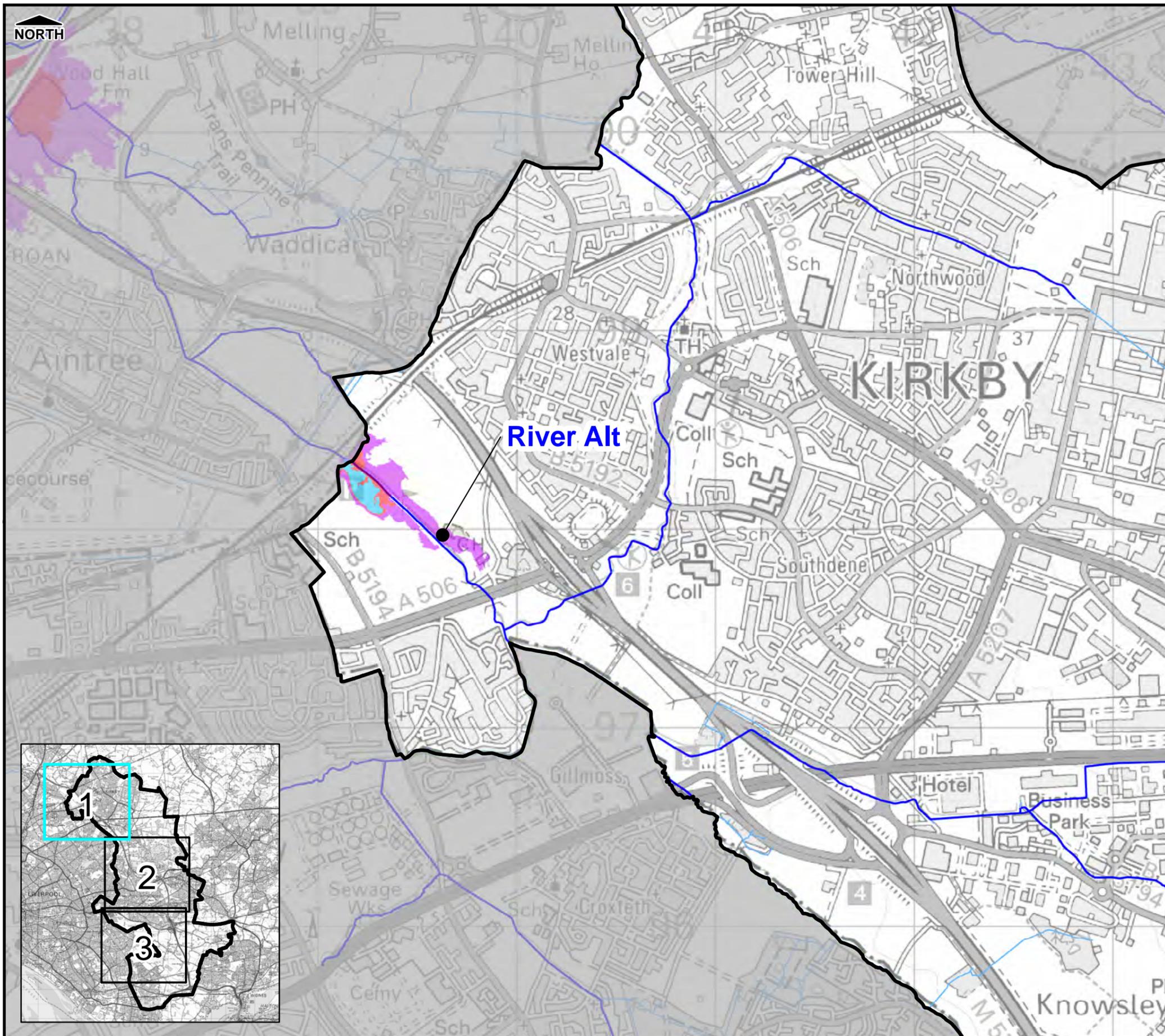
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LEVEL 2 STRATEGIC FLOOD
RISK ASSESSMENT**

Figure B2-2
Environment Agency Flood Zones



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Legend

- Borough Administrative Boundary
- 5% AEP Flood Extent
- 1% AEP Flood Extent
- 1%+CC AEP Flood Extent
- 0.1% AEP Flood Extent
- Main River
- Ordinary Watercourse

NOTES:

The flood extents are taken from the Logwood Mill Brook (2012), Netherley and Halewood (2012), Childwall Brook (2008) and Lower Alt (2010) studies and take into account the presence of existing defences

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LEVEL 2 STRATEGIC FLOOD
RISK ASSESSMENT**

Figure B3-A-1
Actual Risk
Flood Extent

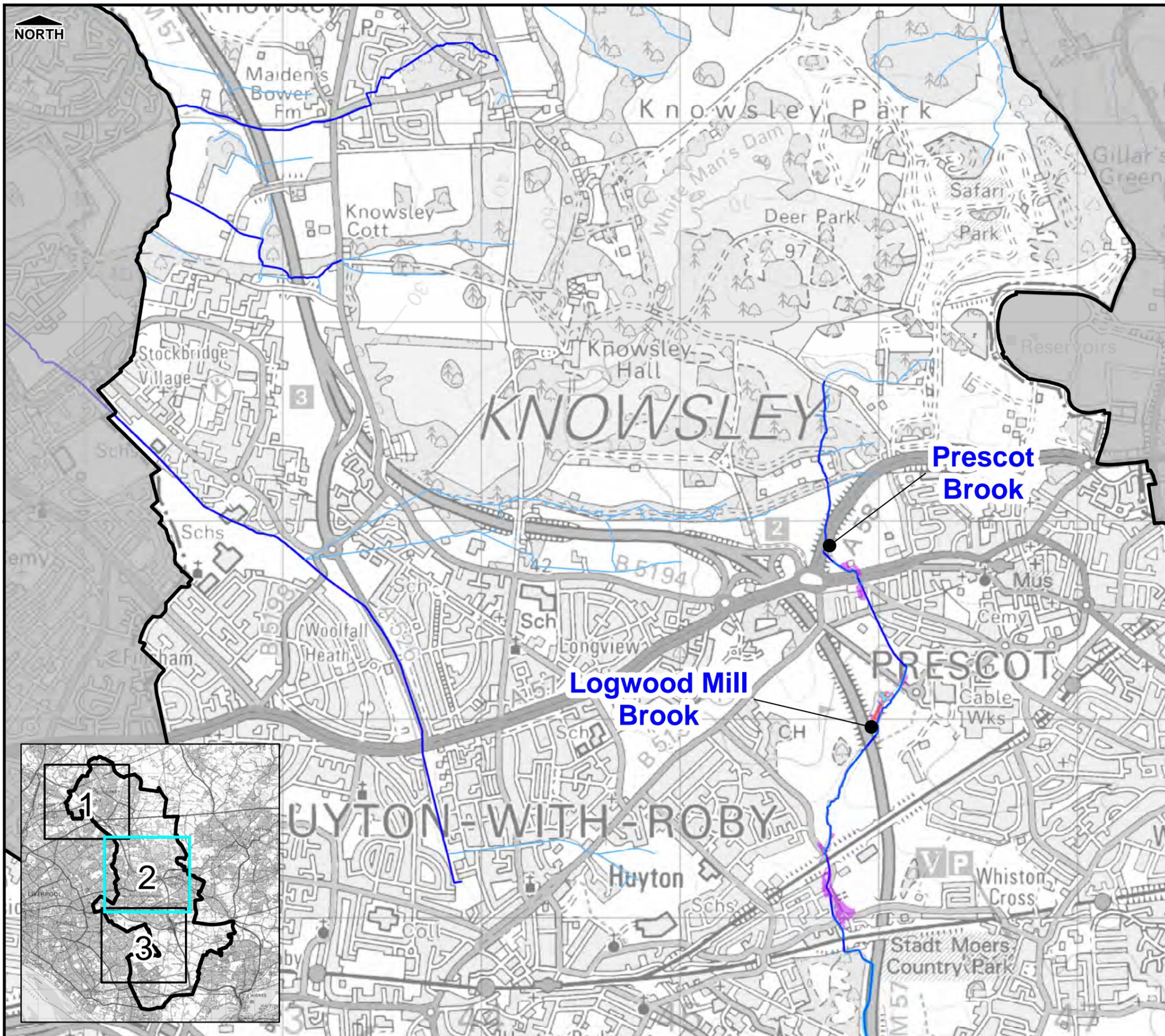


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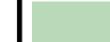
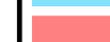
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DRAWING NUMBER CS056421/B3-A-1	REV -
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Legend

-  Borough Administrative Boundary
-  5% AEP Flood Extent
-  1% AEP Flood Extent
-  1%+CC AEP Flood Extent
-  0.1% AEP Flood Extent
-  Main River
-  Ordinary Watercourse

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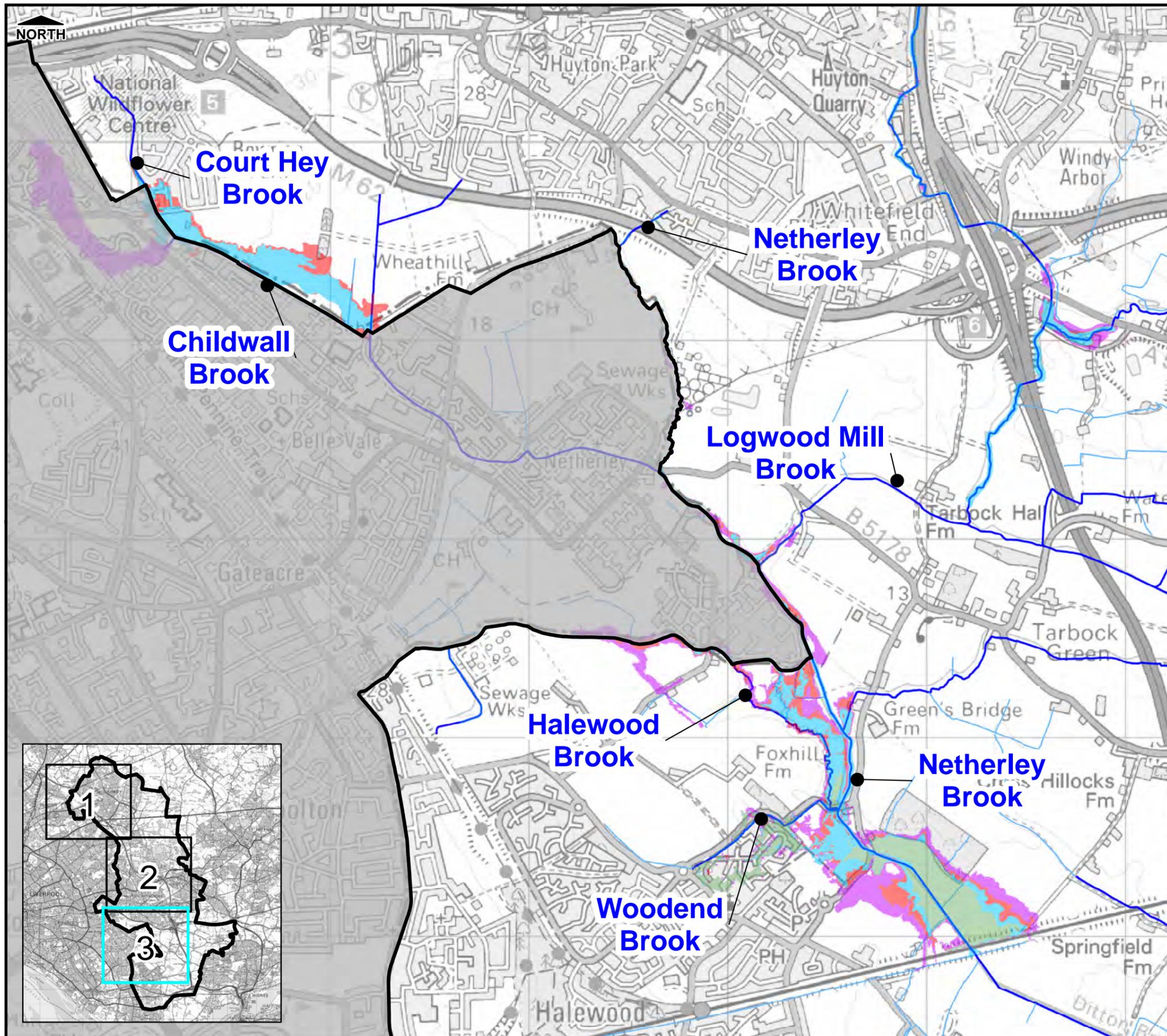
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LEVEL 2 STRATEGIC FLOOD RISK ASSESSMENT**

Figure B3-A-2
Actual Risk
Flood Extent



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Legend

- Borough Administrative Boundary
- 5% AEP Flood Extent
- 1% AEP Flood Extent
- 1%+CC AEP Flood Extent
- 0.1% AEP Flood Extent
- Main River
- Ordinary Watercourse

NOTES:

The flood extents are taken from the Logwood Mill Brook (2012), Netherley and Halewood (2012), Childwall Brook (2008) and Lower Alt (2010) studies and take into account the presence of existing defences

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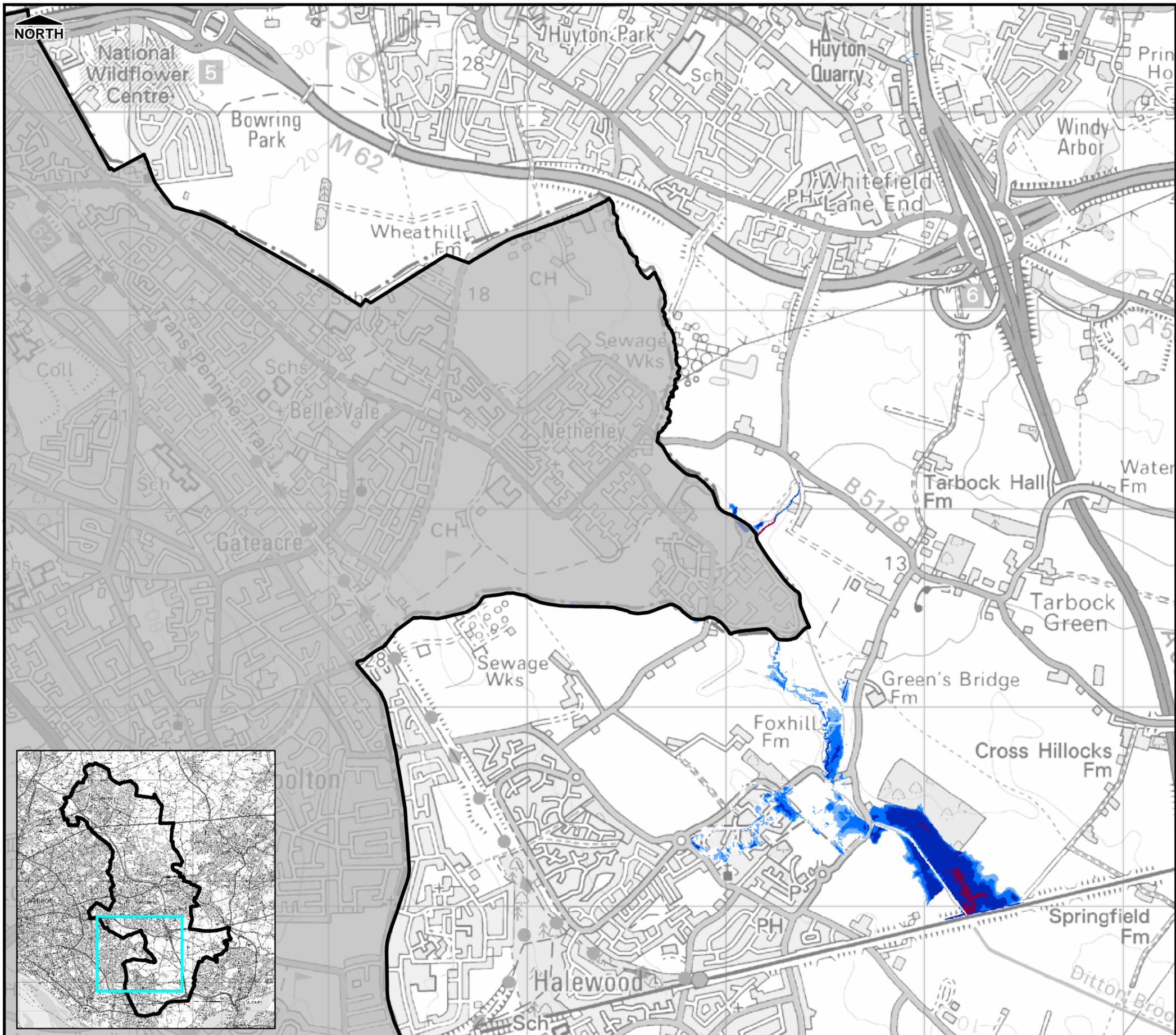
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Figure B3-A-3
Actual Risk
Flood Extent



DRAWING NUMBER CS056421/B3-A-3	REV -
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Legend

-  Borough Administrative Boundary
- Flood Depth (1% AEP Event)**
-  < 0.1m
-  0.1m to 0.25m
-  0.25 to 0.5m
-  0.5 to 1.0m
-  1.0m to 1.5m
-  > 1.5m

NOTES:

The outputs are from the River Netherley and Halewood (2011) and the Logwood Mill Brook (2012) Flood Risk Mapping Studies)

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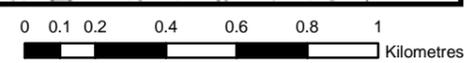
SCALE @ A3 1:20,000	ISSUING OFFICE Sheffield
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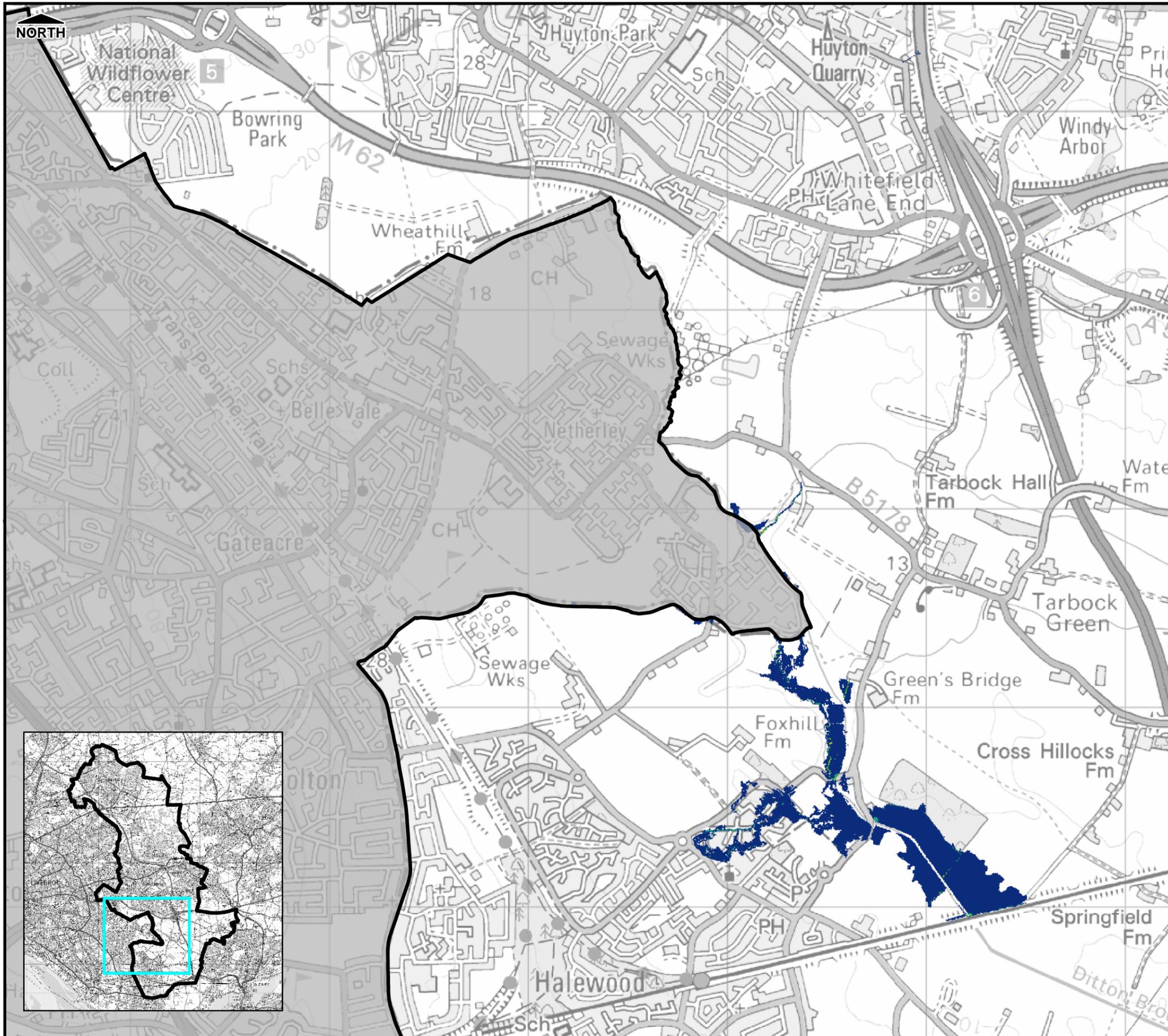
**KNOWSLEY METROPOLITAN
BOROUGH COUNCIL
LEVEL 2 STRATEGIC FLOOD
RISK ASSESSMENT**

Figure B3-B-1
Actual Risk
Flood Depth



DRAWING NUMBER CS056421/B3-B-1	REV -
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Legend

-  Borough Administrative Boundary
- Water Velocity (1% AEP Event)
 -  <math>< 0.5\text{m/s}</math>
 -  0.5m/s to 1.0m/s
 -  1.0m/s to 1.5m/s
 -  1.5m/s to 2.0m/s
 -  2.0m/s to 5.0m/s
 -  > 5.0m/s

NOTES:

The outputs are from the River Netherley and Halewood (2011) and the Logwood Mill Brook (2012) Flood Risk Mapping Studies

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**KNOWSLEY METROPOLITAN
BOROUGH COUNCIL
LEVEL 2 STRATEGIC FLOOD
RISK ASSESSMENT**

Figure B3-C-1
Actual Risk
Flood Velocity

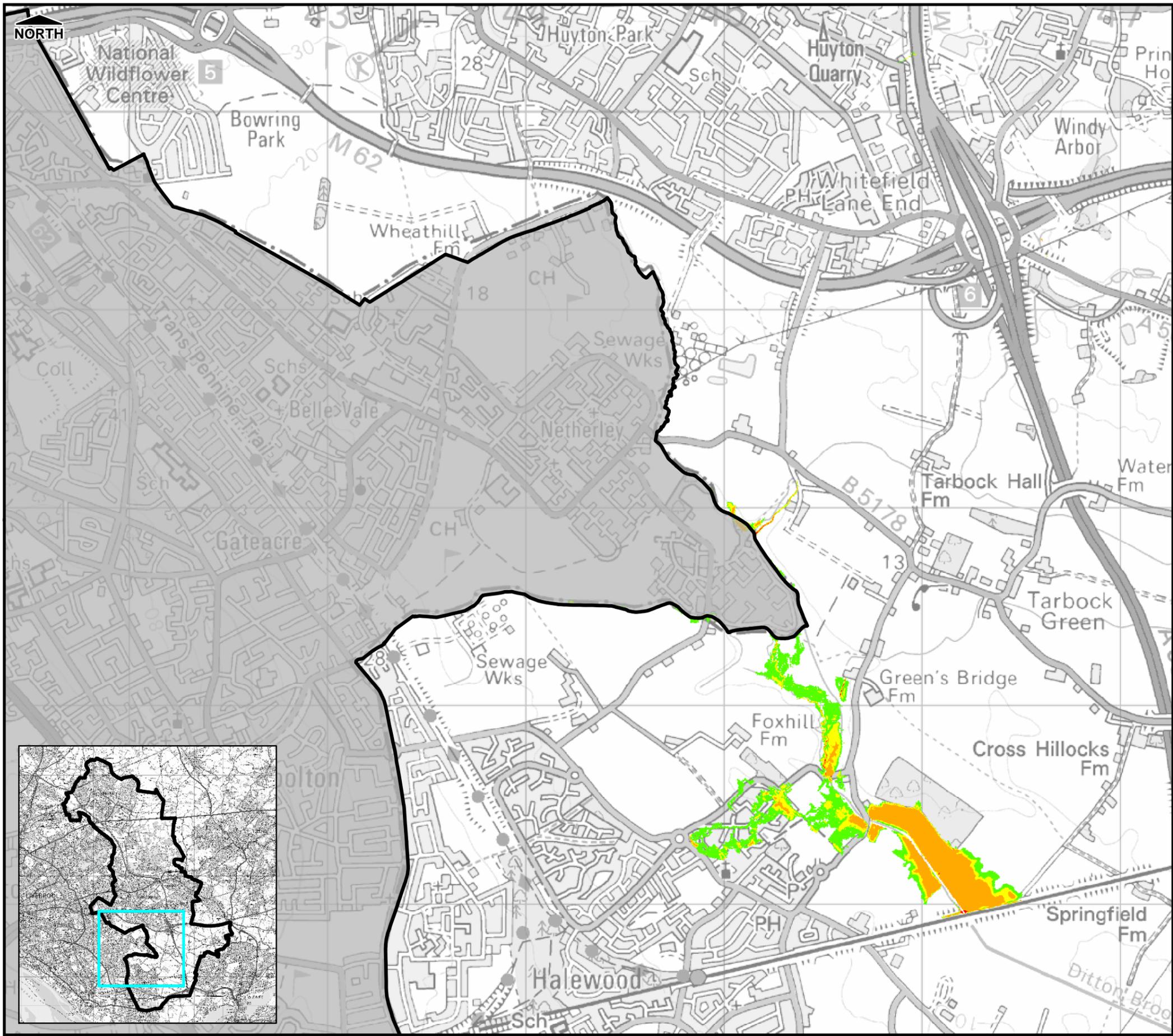


Knowsley Council

CAPITA SYMONDS

DRAWING NUMBER CS056421/B3-C-1	REV -
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Legend

-  Borough Administrative Boundary
- Flood Hazard Rating (1% AEP Event)**
-  < 0.75 (Low)
-  0.75 to 1.25 (Moderate)
-  1.25 to 2.0 (Significant)
-  > 2.0 (Extreme)

NOTES:

The outputs are from the River Netherley and Halewood (2011) and the Logwood Mill Brook (2012) Flood Risk Mapping Studies

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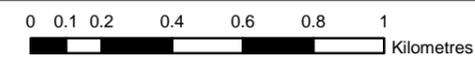
**KNOWSLEY METROPOLITAN BOROUGH COUNCIL
LEVEL 2 STRATEGIC FLOOD RISK ASSESSMENT**

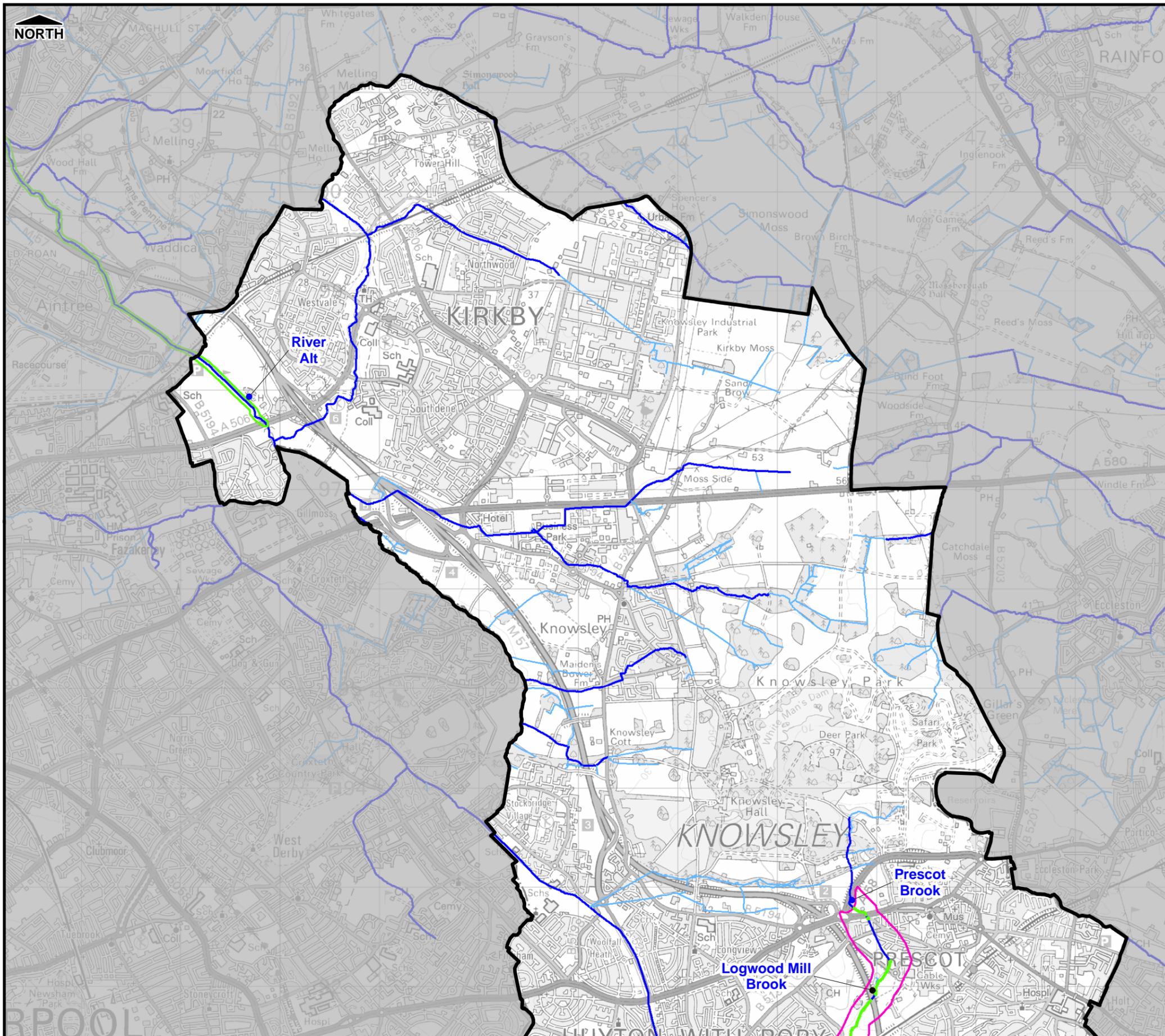
Figure B3-D-1
Actual Risk
Flood Hazard



CAPITA SYMONDS

DRAWING NUMBER CS056421/B3-D-1	REV -
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Legend

-  Borough Administrative Boundary
-  1D Model Boundary
-  2D Model Boundary
-  Main River
-  Ordinary Watercourse

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LEVEL 2 STRATEGIC FLOOD RISK ASSESSMENT**

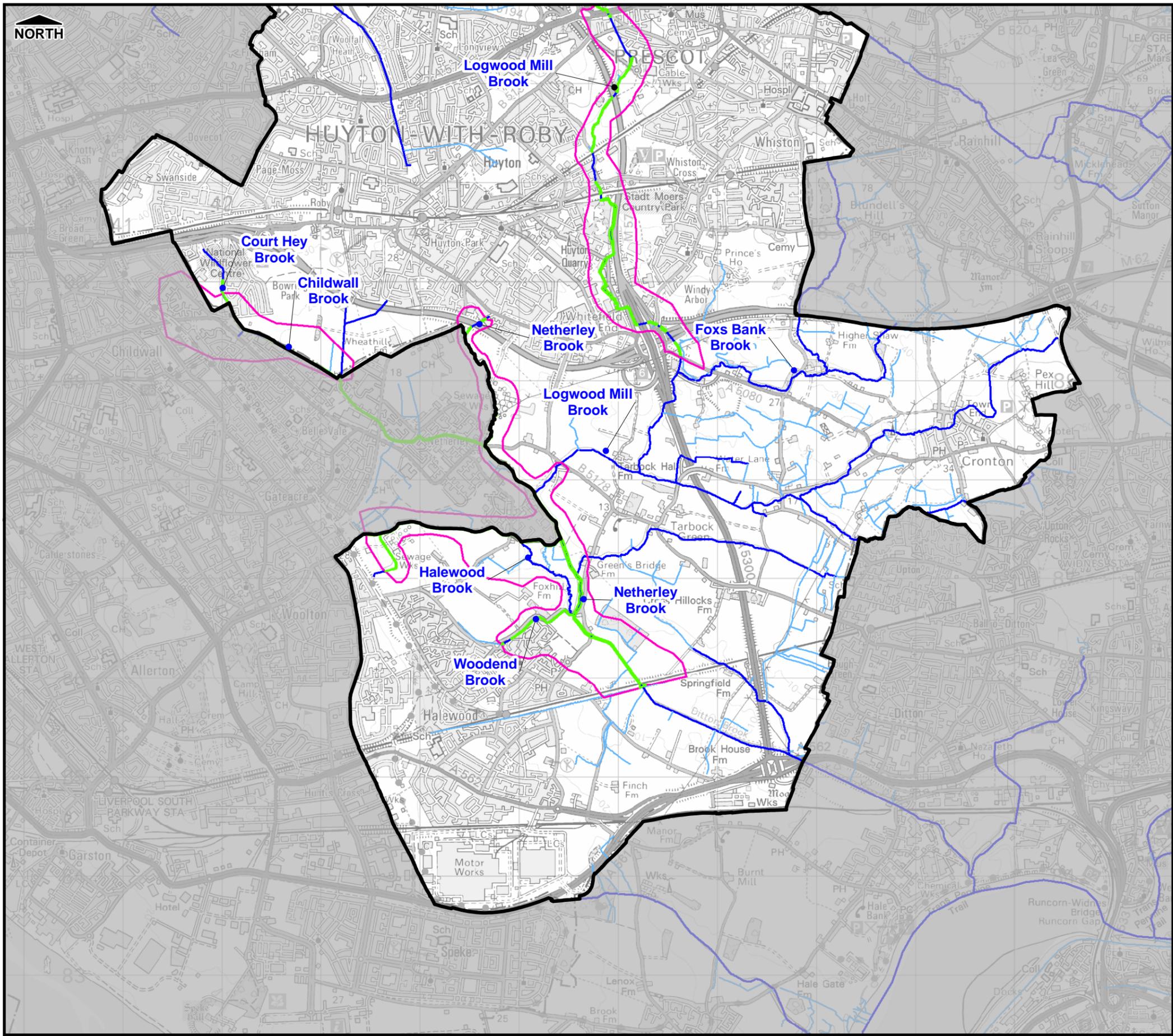
Figure B4-1
Modelled Watercourses



CAPITA SYMONDS

DRAWING NUMBER CS056421/B4-1	REV -
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Legend

-  Borough Administrative Boundary
-  1D Model Boundary
-  2D Model Boundary
-  Main River
-  Ordinary Watercourse

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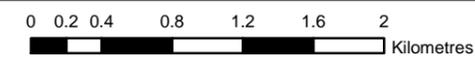
SCALE @ A3 1:40,000	ISSUING OFFICE Sheffield
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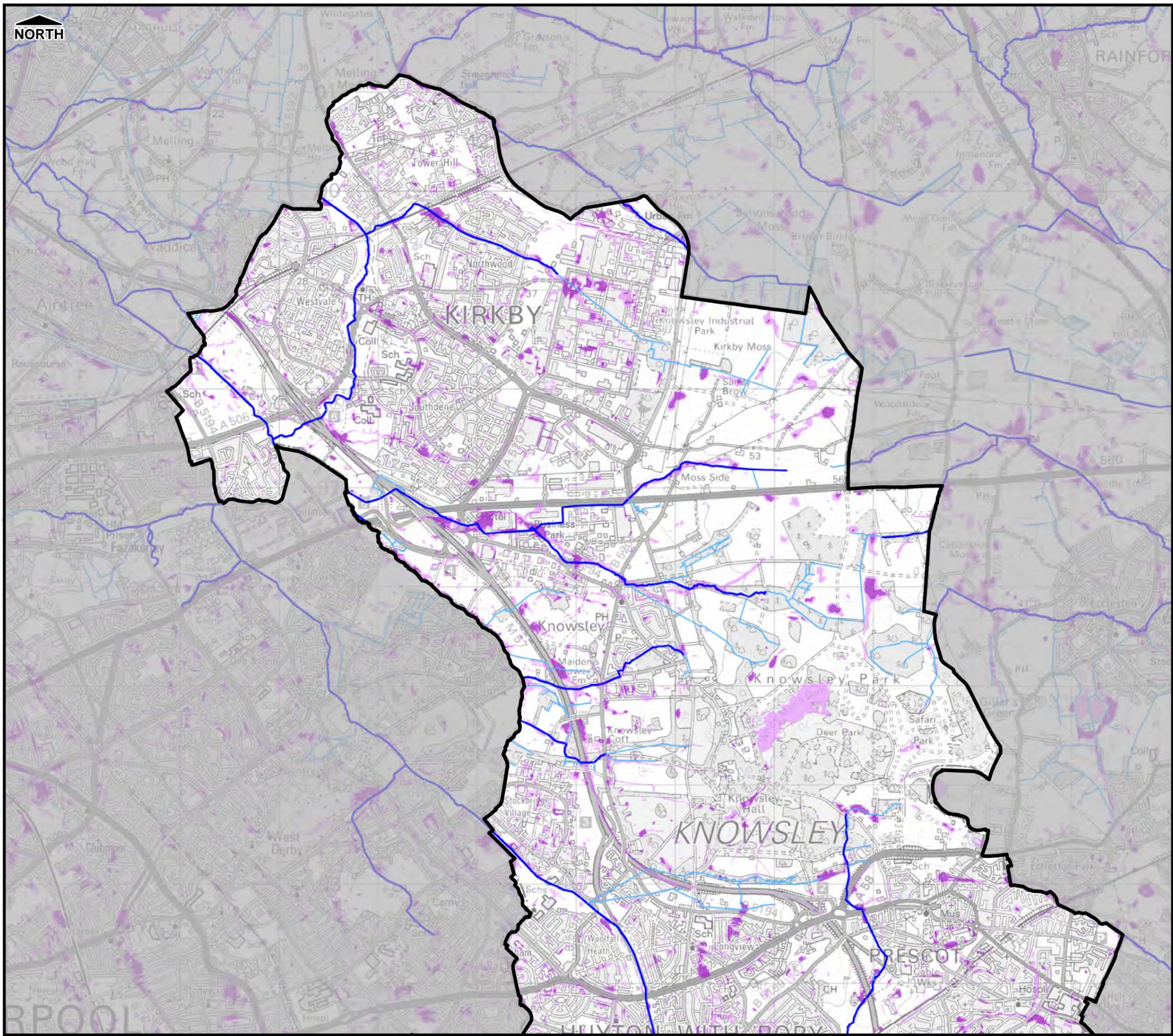
**KNOWSLEY METROPOLITAN BOROUGH COUNCIL
LEVEL 2 STRATEGIC FLOOD RISK ASSESSMENT**

Figure B4-2
Modelled Watercourses



DRAWING NUMBER CS056421/B4-2	REV -
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Legend

- Borough Administrative Boundary
- Main River
- Ordinary Watercourse
- 200yr Surface Water Event (Deep)
- 200yr Surface Water Event (Shallow)

DISCLAIMER:

This map gives an indication of the broad areas likely to be at risk of surface water flooding. It is not suitable for use at an individual property scale due to the method used.

NOTES:

The outputs are from the Environment Agency Flood Map for Surface Water Data Set (2010).

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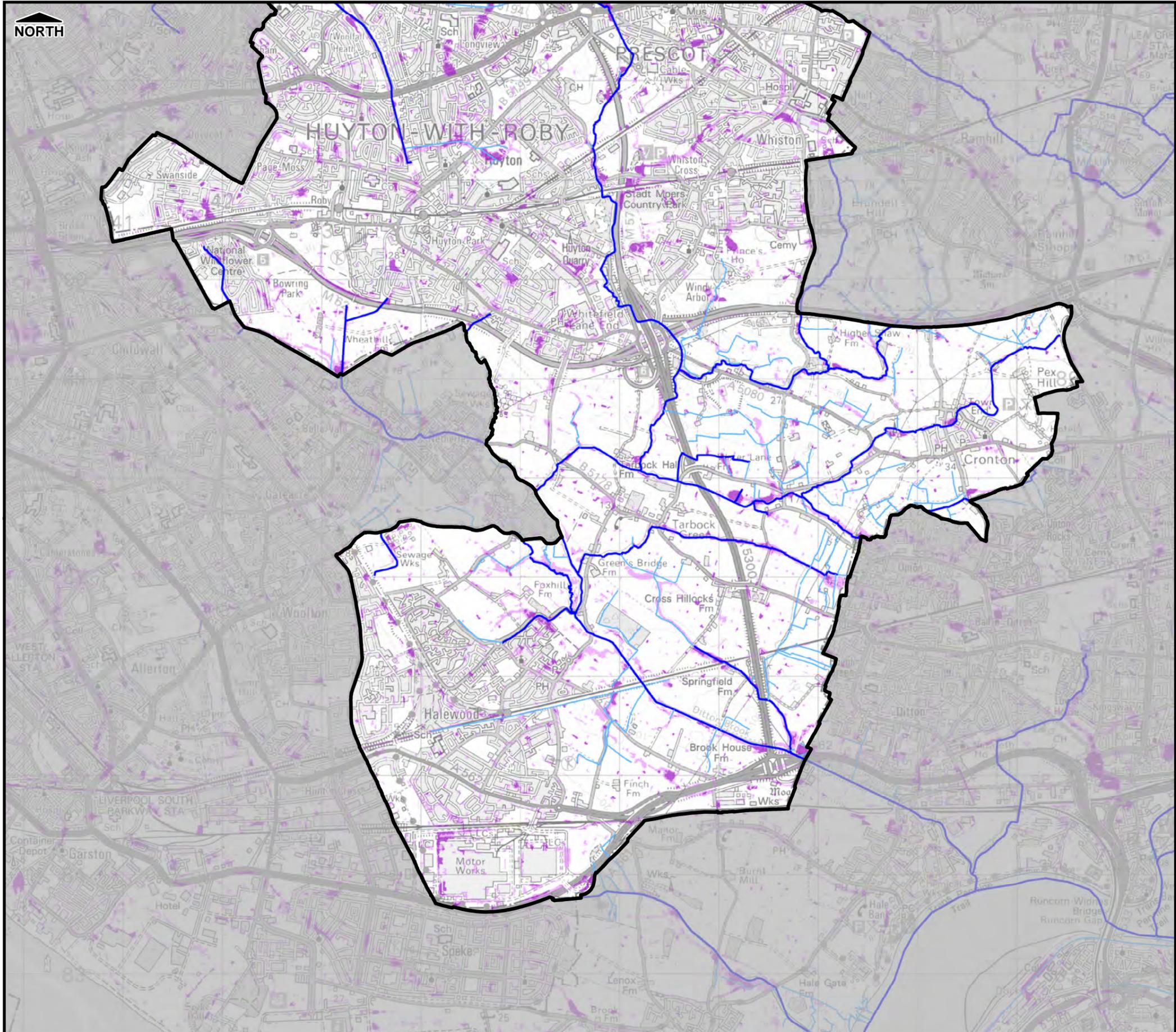
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LEVEL 2 STRATEGIC FLOOD
RISK ASSESSMENT**

Figure B5-1
Environment Agency Flood Map
for Surface Water



DRAWING NUMBER CS056421/B5-1	REV -
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Legend

-  Borough Administrative Boundary
-  Main River
-  Ordinary Watercourse
-  200yr Surface Water Event (Deep)
-  200yr Surface Water Event (Shallow)

DISCLAIMER:

This map gives an indication of the broad areas likely to be at risk of surface water flooding. It is not suitable for use at an individual property scale due to the method used.

NOTES:

The outputs are from the Environment Agency Flood Map for Surface Water Data Set (2010).

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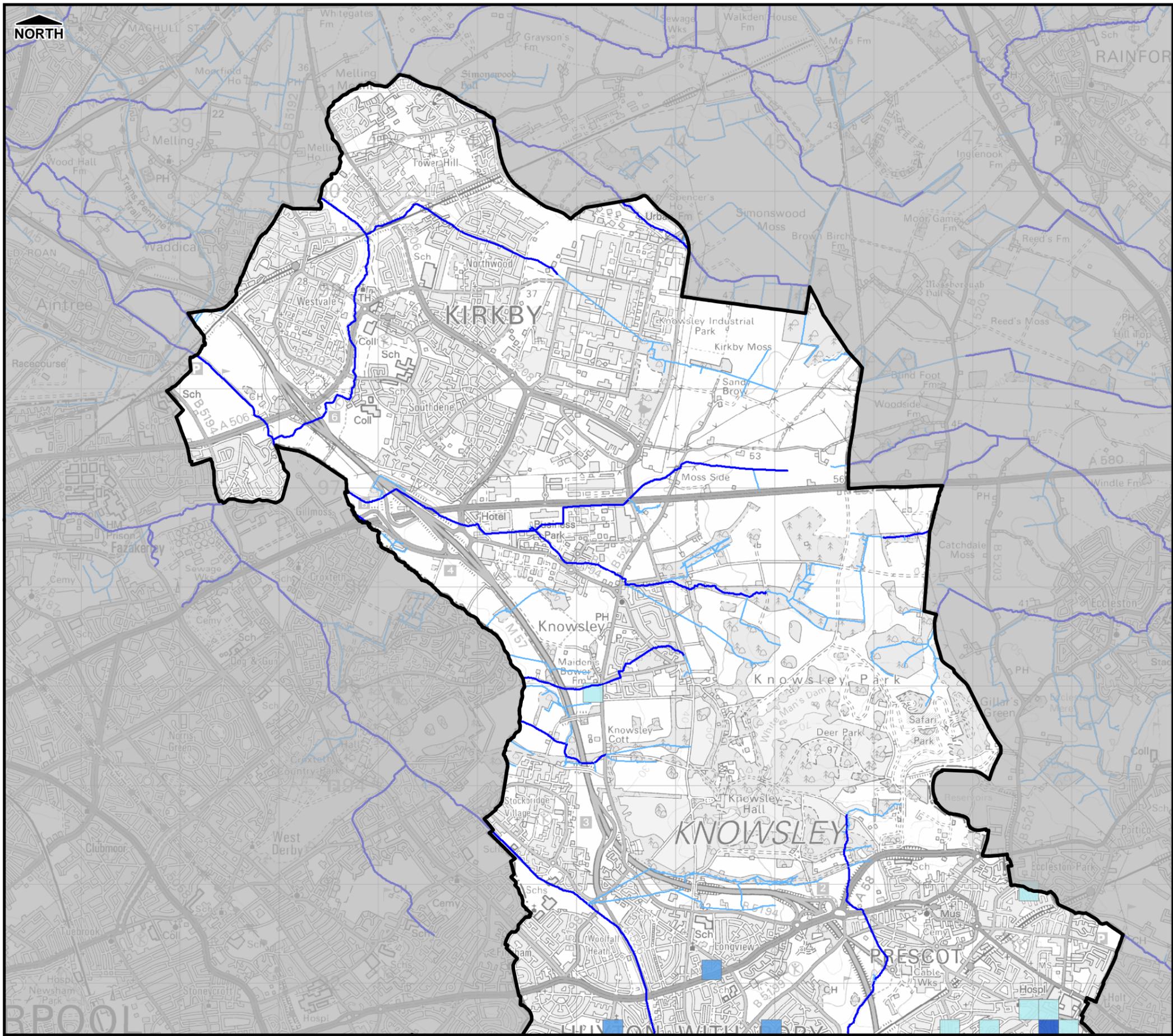
**KNOWSLEY METROPOLITAN
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LEVEL 2 STRATEGIC FLOOD
RISK ASSESSMENT**

**Figure B5-2
Environment Agency Flood Map
for Surface Water**



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Legend

-  Borough Administrative Boundary
-  Main River
-  Ordinary Watercourse

Flooding incidents from 1st April 2008 - 3rd May 2012:

-  1 - 2
-  3 - 5
-  6 - 9
-  > 10

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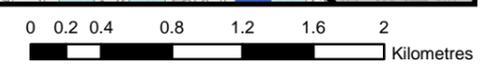
**KNOWSLEY METROPOLITAN BOROUGH COUNCIL
LEVEL 2 STRATEGIC FLOOD RISK ASSESSMENT**

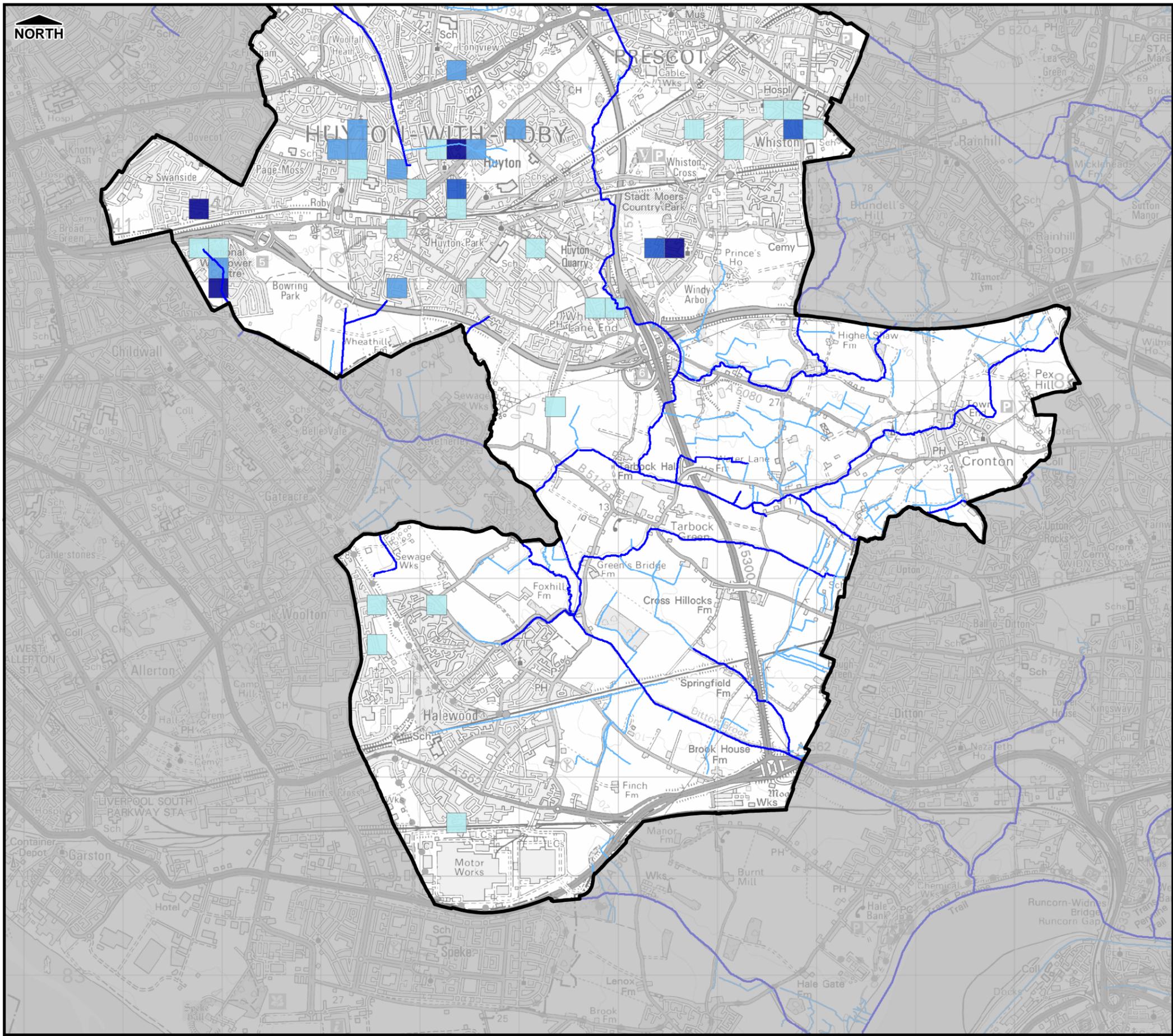
**Figure B6-1
Number of Sewer Related
Surface Water Flooding Incidents**



CAPITA SYMONDS

DRAWING NUMBER CS056421/B6-1	REV -
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Legend

-  Borough Administrative Boundary
-  Main River
-  Ordinary Watercourse

Flooding incidents from 1st April 2008 - 3rd May 2012:

-  1 - 2
-  3 - 5
-  6 - 9
-  > 10

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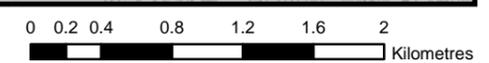
SCALE @ A3 1:40,000	ISSUING OFFICE Sheffield
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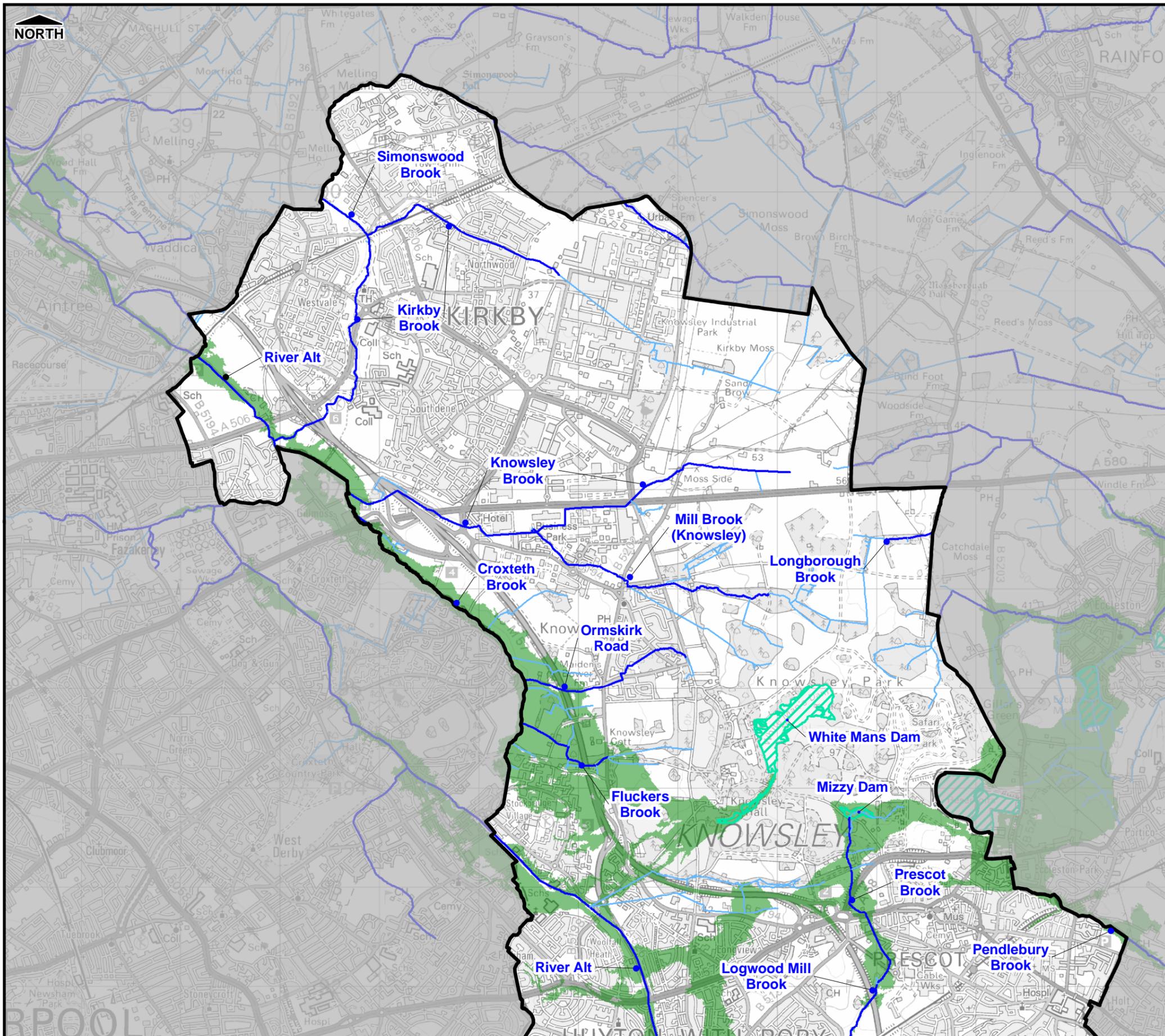
**KNOWSLEY METROPOLITAN
BOROUGH COUNCIL
LEVEL 2 STRATEGIC FLOOD
RISK ASSESSMENT**

**Figure B6-2
Number of Sewer Related
Surface Water Flooding Incidents**



DRAWING NUMBER CS056421/B6-2	REV -
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Legend

-  Borough Administrative Boundary
-  Main River
-  Ordinary Watercourse
-  Lakes/Reservoirs
-  Maximum Extent of Reservoir Flooding

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RISK ASSESSMENT**

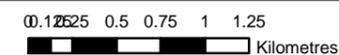
Figure B7-1
Reservoir Flooding

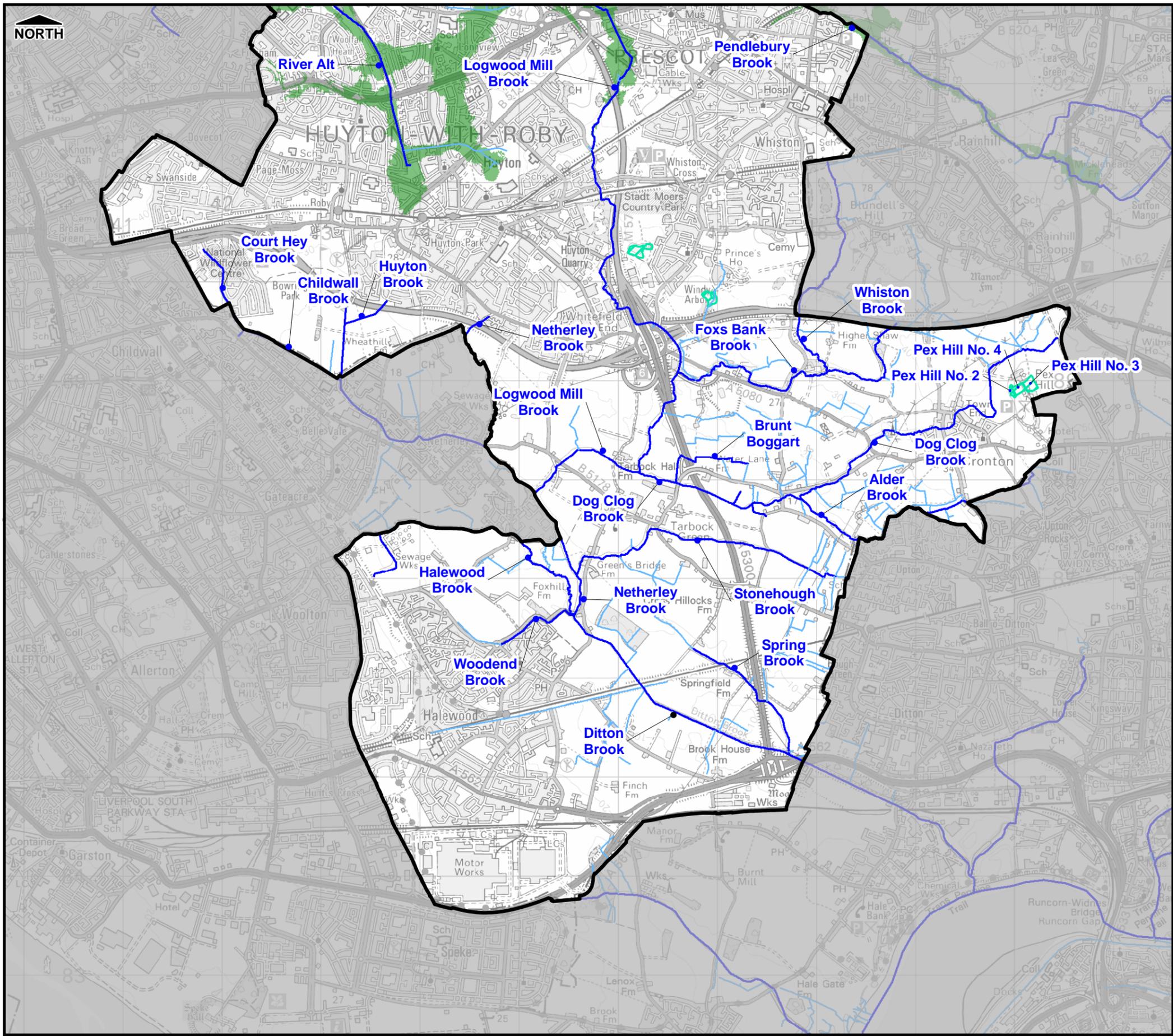


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CAPITA SYMONDS

DRAWING NUMBER CS056421/B7-1	REV -
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Legend

-  Borough Administrative Boundary
-  Main River
-  Ordinary Watercourse
-  Lakes/Reservoirs
-  Maximum Extent of Reservoir Flooding

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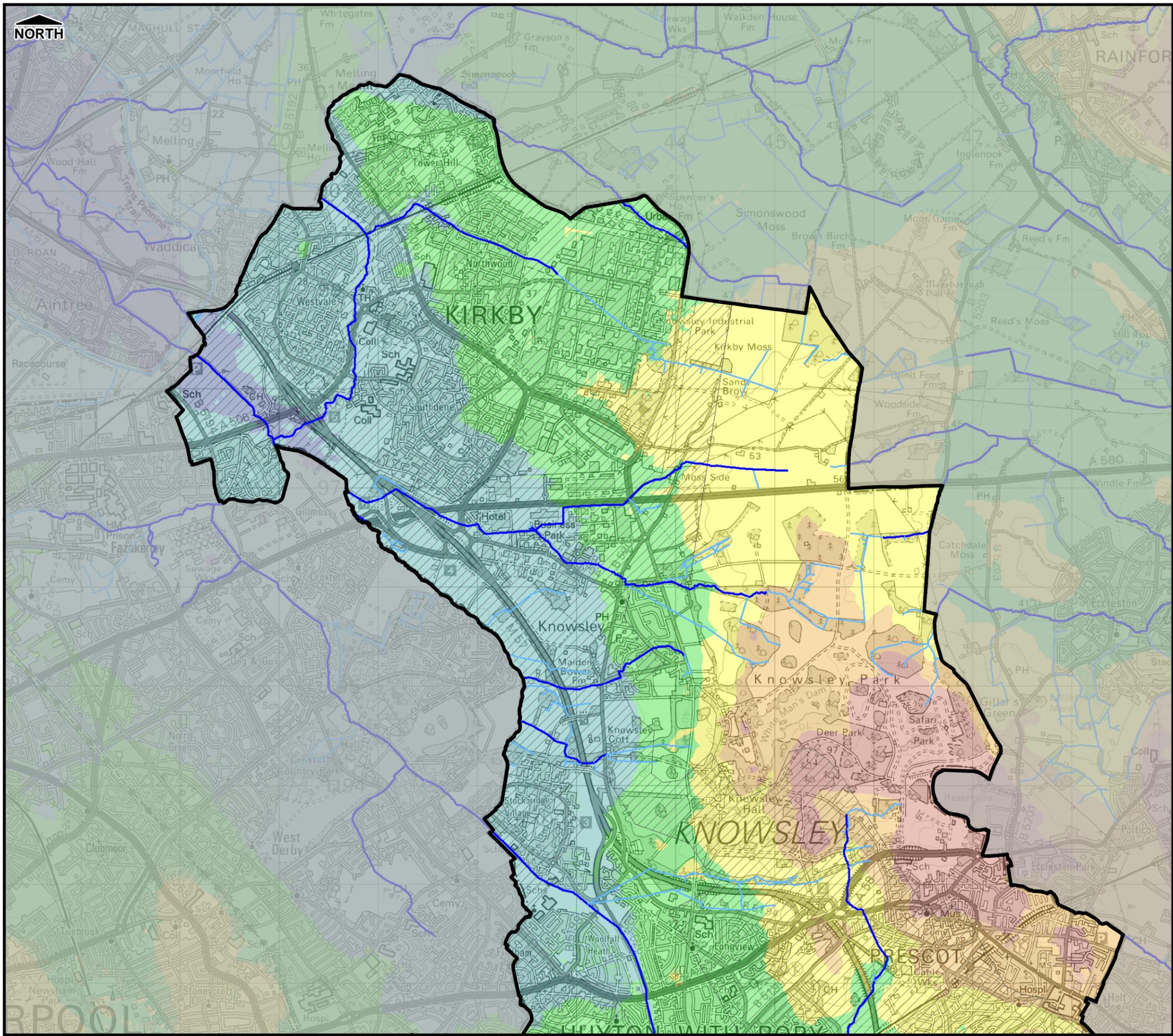
**KNOWSLEY METROPOLITAN
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LEVEL 2 STRATEGIC FLOOD
RISK ASSESSMENT**

Figure B7-2
Reservoir Flooding



DRAWING NUMBER CS056421/B7-2	REV -
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NORTH

Legend

- Borough Administrative Boundary
- Main River
- Ordinary Watercourse
- LiDAR Coverage (remainder SAR data)

Terrain Height (mAOD)

- < 15
- 15 - 30
- 30 - 45
- 45 - 60
- 60 - 75
- >75

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BOROUGH COUNCIL
LEVEL 2 STRATEGIC FLOOD
RISK ASSESSMENT**

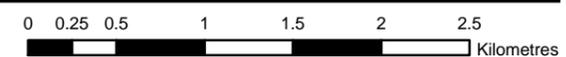
Figure B8-1
LiDAR

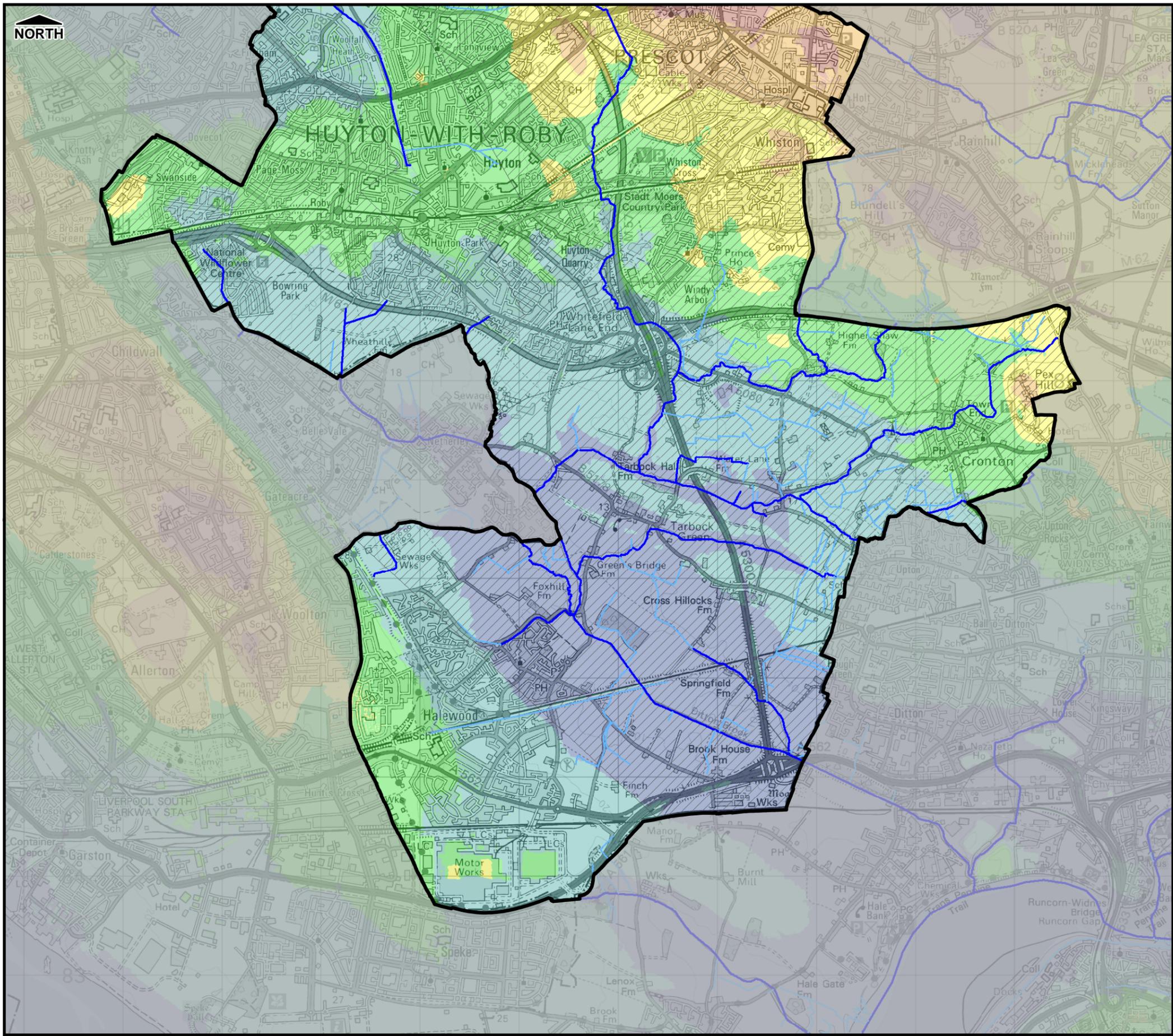


Knowsley Council

CAPITA SYMONDS

DRAWING NUMBER CS056421/B8-1	REV -
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Legend

- Borough Administrative Boundary
- Main River
- Ordinary Watercourse
- LiDAR Coverage (remainder SAR data)

Terrain Height (mAOD)

- < 15
- 15 - 30
- 30 - 45
- 45 - 60
- 60 - 75
- >75

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**KNOWSLEY METROPOLITAN
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LEVEL 2 STRATEGIC FLOOD
RISK ASSESSMENT**

Figure B8-2
LiDAR

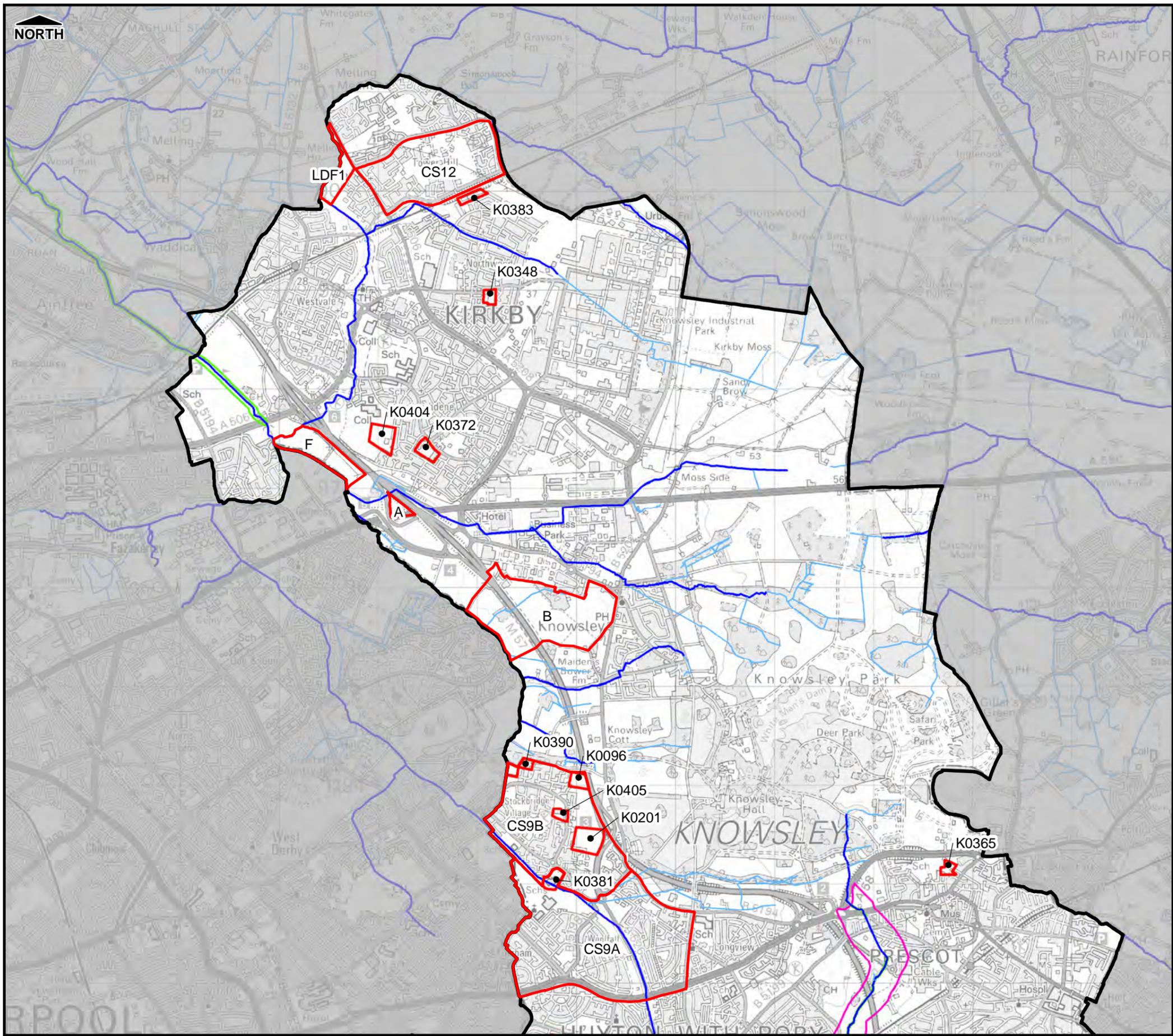


Knowsley Council

CAPITA SYMONDS

DRAWING NUMBER CS056421/B8-2	REV -
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Legend

-  Borough Administrative Boundary
-  Main River
-  Ordinary Watercourse
-  Site under consideration
-  1D Model Boundary
-  2D Model Boundary

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RISK ASSESSMENT**

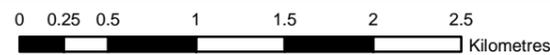
Figure B9-1
Sites considered as part of the
Study and Model Extents

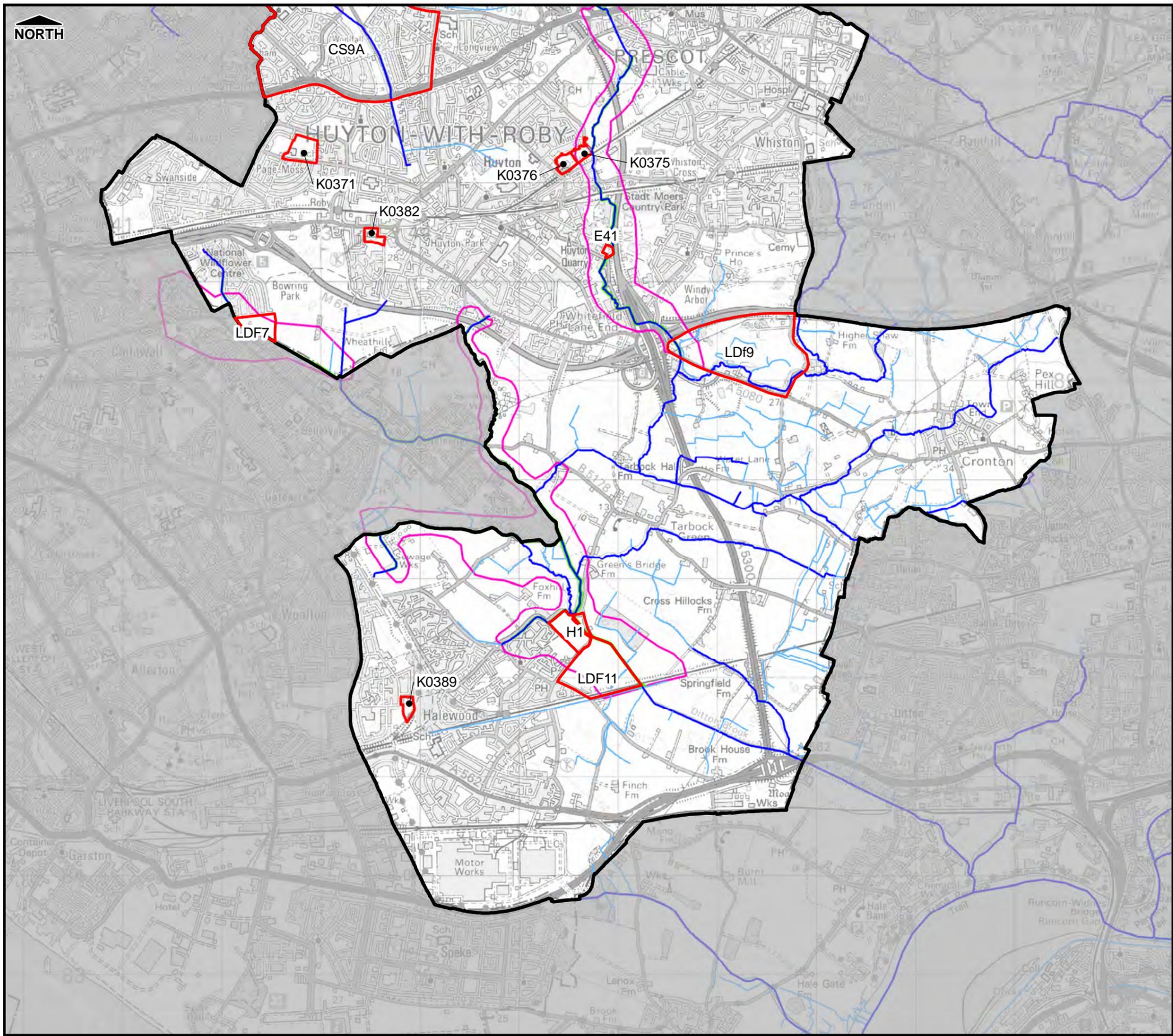


Knowsley Council

CAPITA SYMONDS

DRAWING NUMBER CS056421/B9-1	REV -
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Legend

-  Borough Administrative Boundary
-  Main River
-  Ordinary Watercourse
-  Site under consideration
-  1D Model Boundary
-  2D Model Boundary

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LEVEL 2 STRATEGIC FLOOD
RISK ASSESSMENT**

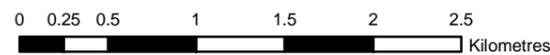
Figure B9-2
Sites considered as part of the
Study and Model Extents

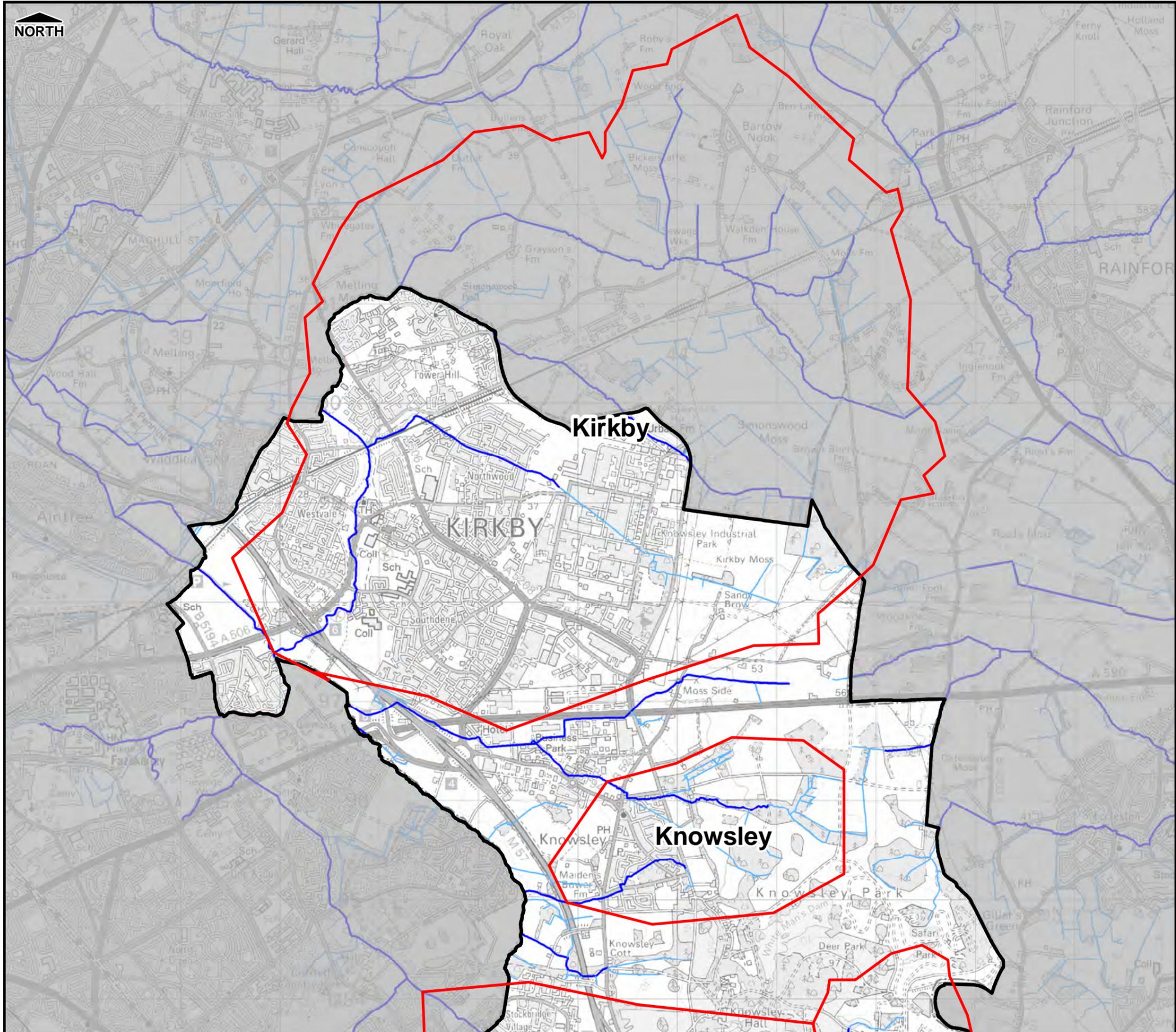


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CAPITA SYMONDS

DRAWING NUMBER CS056421/B9-2	REV -
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- Legend**
- Critical Drainage Areas
 - Borough Administrative Boundary
 - Main River
 - Ordinary Watercourse

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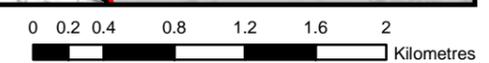
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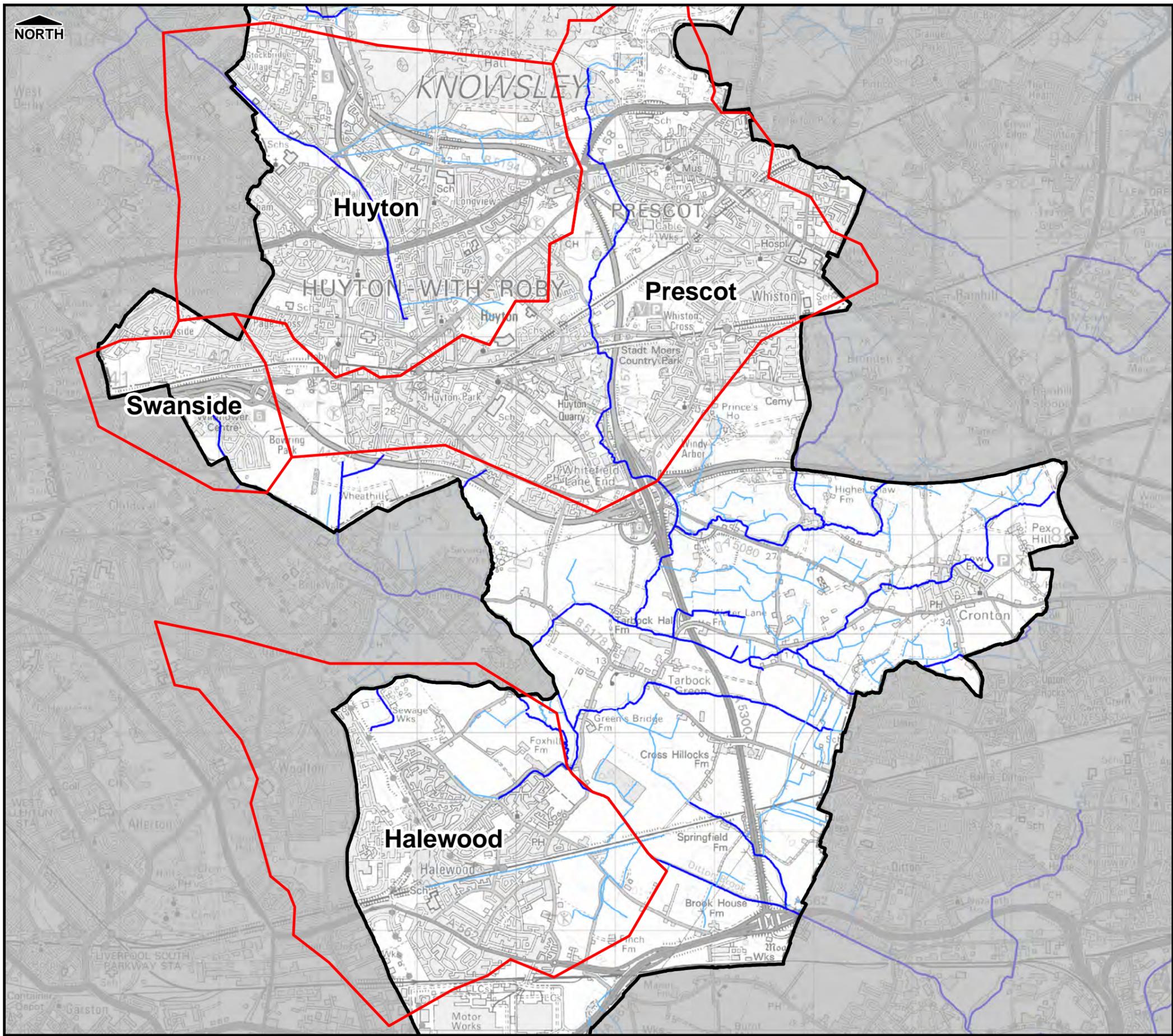
**KNOWSLEY METROPOLITAN
BOROUGH COUNCIL
LEVEL 2 STRATEGIC FLOOD
RISK ASSESSMENT**

Figure B10-1
Critical Drainage Areas



DRAWING NUMBER CS056421/B10-1	REV -
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Legend

- Critical Drainage Areas
- Borough Administrative Boundary
- Main River
- Ordinary Watercourse

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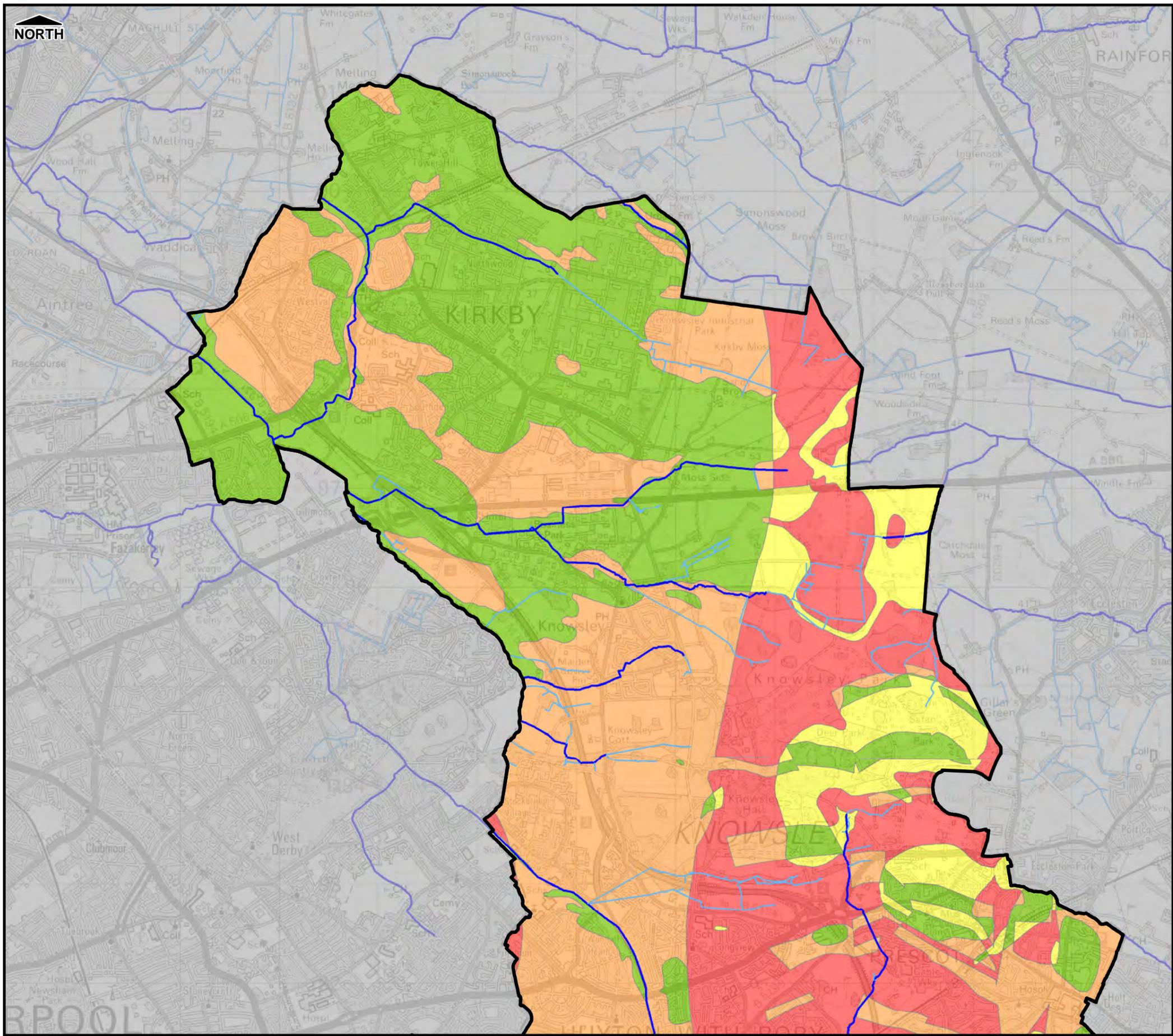
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BOROUGH COUNCIL
LEVEL 2 STRATEGIC FLOOD
RISK ASSESSMENT**

Figure B10-2
Critical Drainage Areas



DRAWING NUMBER CS056421/B10-2	REV -
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Legend

-  Borough Administrative Boundary
-  Main River
-  Ordinary Watercourse

Potential Suitability for SuDS

-  High
-  Medium 1
-  Medium 2
-  Low

Notes

Areas identified as High Probability are those that combine a permeable drift (or no drift) above a Sandstone solid geology. The Medium Probability (1) class consists of those that are permeable drift above Coal Measures, whilst the Medium Probability Class (2) consists of impermeable/other types of drift above Sandstone solid geology. The Low Probability Class consists of impermeable/other types of drift above Coal Measures.

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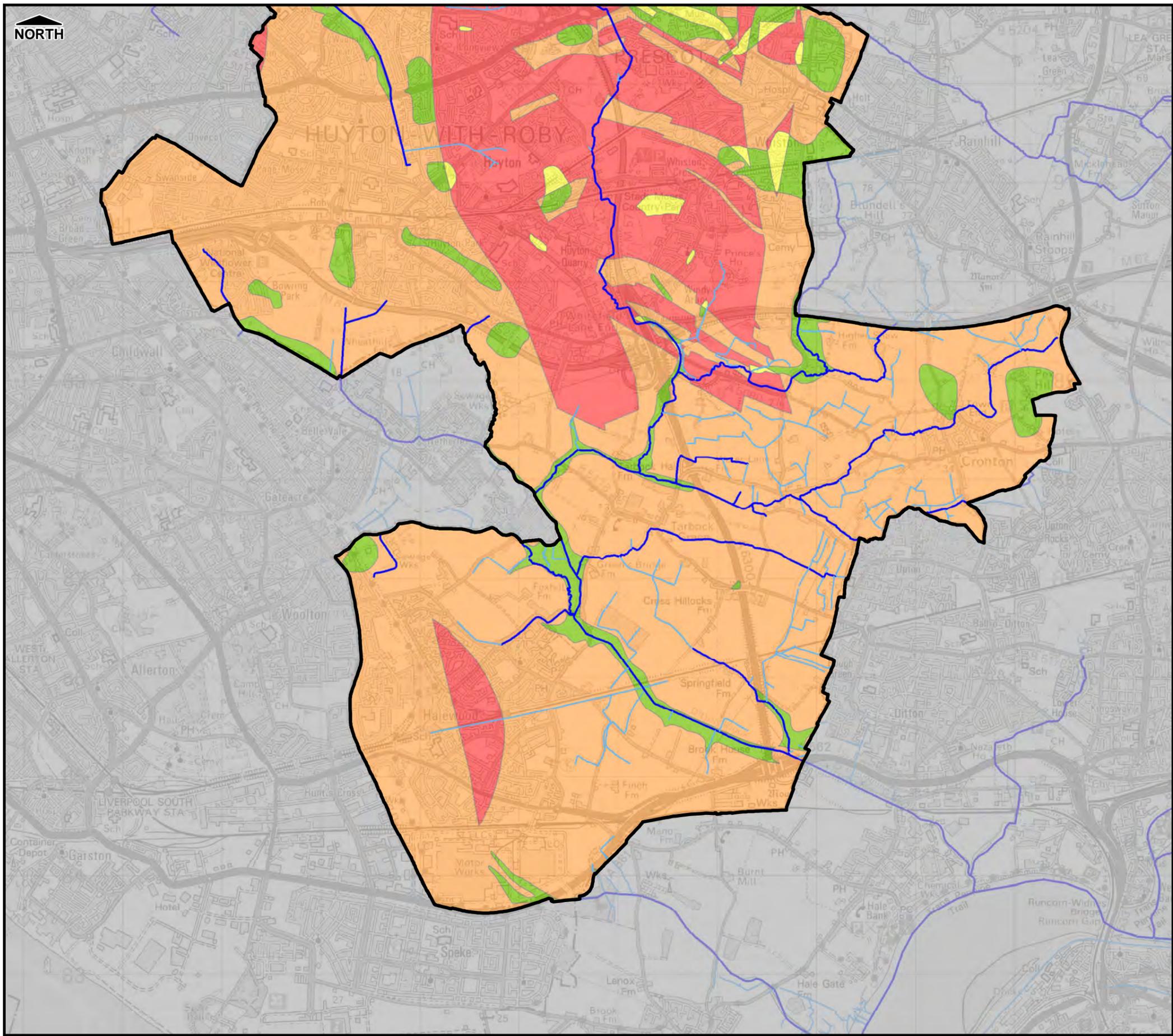
**KNOWSLEY METROPOLITAN
BOROUGH COUNCIL
LEVEL 2 STRATEGIC FLOOD
RISK ASSESSMENT**

**Figure B11-1
Potential Suitability for SuDS**



DRAWING NUMBER CS056421/B11-1	REV -
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Legend

-  Borough Administrative Boundary
-  Main River
-  Ordinary Watercourse

Potential Suitability for SuDS

-  High
-  Medium 1
-  Medium 2
-  Low

Notes

Areas identified as High Probability are those that combine a permeable drift (or no drift) above a Sandstone solid geology. The Medium Probability (1) class consists of those that are permeable drift above Coal Measures, whilst the Medium Probability Class (2) consists of impermeable/other types of drift above Sandstone solid geology. The Low Probability Class consists of impermeable/other types of drift above Coal Measures.

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**KNOWSLEY METROPOLITAN
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RISK ASSESSMENT**

**Figure B11-2
Potential Suitability for SuDS**



DRAWING NUMBER CS056421/B11-2	REV -
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Volume 2: Glossary

Term	Definition
Actual risk	<p>The flood risk posed from river, streams or tidal sources when taking into account the presence of defences.</p> <p>Where there are no defences then the Actual flood extent is unlikely to differ from the risk presented in the Environment Agency's Flood Zone Maps. Where defences exist and have been taken into account in detailed modelling then the extents will show the effect that those defences have on flood risk.</p> <p>It should be noted that the Actual risk assumes that the flood defences remain effective and fully operational during a flood event and no allowance is made for failure of the defences through breach. If a flood event overtops the defence then the extent reflects the volume of water that overtops the defence and makes no allowance for scour or erosion of the defence under such conditions.</p> <p>Actual risk covers scenarios with a 5%, 1% and 1% plus an allowance for climate change probability of occurring in any given year.</p>
AEP	Annual exceedance of probability: the annual chance of experiencing a flood with the corresponding flood magnitude, for example a 1% AEP flood is a flood with a flow magnitude that has a 1% chance of occurring in each and every year.
Areas Susceptible to Groundwater Flooding (AStGWF)	A strategic scale map showing groundwater flood areas on a 1km square grid. Shows the proportion of each grid square where geological and hydrogeological conditions show that water in the ground might emerge.
Areas Susceptible to Surface Water Flooding (AStSWF)	National scale surface water flood modelling published in 2009. Three bandings are indicated, showing areas that are Less, Intermediate and More Susceptible to surface water flooding.
CFMP	Catchment Flood Management Plan: A high-level planning strategy through which the Environment Agency works with their key decision makers within a river catchment to identify and agree policies to secure the long-term sustainable management of flood risk.
Climate Change	Long term variations in global temperature and weather patterns caused by natural and human actions.
DEFRA	Department for Environment, Food and Rural Affairs: The Government department responsible for environmental protection, agriculture, food production and food standards as well as fisheries and rural communities.

Term	Definition
Developable Area	<p>The area or proportion of the site that is developable for a specific type of development/vulnerability class without application of the exception test.</p> <p>The areas defined in this SFRA are as follows:</p> <ul style="list-style-type: none"> • Very High Risk Areas – Water Compatible / Essential Infrastructure only • High Risk Areas – Less Vulnerable development • Moderate Risk Areas – More Vulnerable development • Low Risk Areas – All types of development
Drift Geology	The name for all material of glacial origin found anywhere on land or at sea. Typically refers to deposits made up to 2.6 million years.
EA	Environment Agency: A non-departmental Agency reporting to DEFRA charged with protecting or enhancing the Environment and managing flood risk and pollution in England.
Exception Test	The Exception Test should be applied following the application of the Sequential Test. In order to pass the exception test, it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, is on developable land, the development is safe and will not increase flood risk elsewhere.
Floodplain	Area of land that borders a watercourse, an estuary or the sea, over which water flows in time of flood, or would flow but for the presence of flood defences where they exist.
Flood Map for Surface Water (FMfSW)	National scale surface water flood modelling published in 2009. Two bandings are provided, 'Surface Water Flooding' and 'Deeper Surface Water Flooding', which indicate surface water flooding greater than 0.1m and greater than 0.3m respectively. There are outputs available for events with a 1 in 30 and 1 in 200 chance of occurring in any given year.
Flood risk	A combination of two components: the chance (or probability) of a particular flood event and the impact (or consequence) that the event would cause if it occurred.
Flood Defence	Flood walls and embankments intended to protect an area against flooding.
Flood Risk Vulnerability	Classifications presented within the Technical Guidance to the National Planning Policy Framework, which indicates the vulnerability of a specific land-use to flood risk. For example houses and hospitals are less vulnerable to flooding than shops and industry
FRA	Flood Risk Assessment: A study to assess the risk of flooding caused by development both now and in the future. It includes flooding to other areas in addition to flooding on site.
Flood risk management	Flood risk management can reduce the probability of occurrence through the management of land, river systems and flood defences, and reduce the impact through influencing development in flood risk areas, flood warning and emergency response.

Term	Definition
Flood Zones	This refers to the Flood Zones in accordance with Table 1 of the Technical Guidance to the National Planning Policy Framework ¹ . Flood Zone 1 is land with a probability of flooding on average once in over 1000 years. Flood Zone 2 is land with a probability of flooding on average between once in 100 and once in 1000 years. Flood Zone 3 is land with a probability of flooding on average more than once in 100 years. Flood Zone 3b is a functional floodplain. For the purpose of the SFRA, where the 'actual risk' is referred to this reflects the vulnerability of land to flooding taking into account the presence of flood defences.
Flood Zone Maps	Maps produced by the Environment Agency depicting the extent of flood zones.
Fluvial	Relating to a watercourse (rivers or streams)
Groundwater	Water stored underground in areas of permeable rocks, known as aquifers. Consistently high levels of groundwater can lead to groundwater flooding.
JFLOW	Hydraulic modelling software developed by JBA to simulate the hydraulics of waterways in 2D.
KMBC	Knowsley Metropolitan Borough Council
Local Plan	The plan for the future development of the local area drawn up by the local planning authority in consultation with the community.
Main River	A statutory type of watercourse in England and Wales which are usually larger streams and rivers, but may also include some smaller watercourses. They must be defined as a watercourse on a main river map. It can include any structure or appliance for controlling or regulating the flow of water in, into or out of a main river. The Environment Agency's powers to carry out flood defence works apply to main rivers only.
NFCDD	National Flood and Coastal Defence Database: Mapping data showing the areas at risk of flooding and data about the defences themselves (their type, location and condition) and the areas that benefit from those defences.
NGR	National Grid Reference
NPPF	National Planning Policy Framework ¹ : the document and its supporting Technical Guidance ² that sets out the Government's planning policies for England and how these are expected to be applied. It provides a framework within which local and neighbourhood plans can be produced to reflect local needs and priorities.
Ordinary Watercourse	All watercourses that are not designated main river, and which are the responsibility of Local Authorities or, where they exist, Internal Drainage Boards.
Residual risk	Flood risks resulting from an event more severe than for which particular flood defences have been designed to provide protection.

¹ National Planning Policy Framework, March 2012.

² Technical Guidance to the National Planning Policy Framework, March 2012.

Term	Definition
Sequential Test	A test to determine if other sites are available in areas with a lower probability of flooding that would be appropriate to the type of development or land use proposed.
SIRS	Sewer Incident Reporting System. A now superseded database of historical incidents associated with United Utilities sewer network. Replaced in 2008 by the Water Incident Reporting System (WIRS)
SFRA	Strategic Flood Risk Assessment: There are 2 levels of an SFRA. Level 1 is a tool used by planning authorities to assess flood risk for spatial planning, producing development briefs, setting constraints, informing sustainability appraisals, identifying locations of emergency planning measures and requirements for flood risk assessments. It provides information on flood risk within the borough and guidance on application of the Sequential Test and Flood Risk Assessments for development planning. A Level 2 SFRA (this report) is a more detailed assessment produced where the Exception Test is required for a potential development site
SoP	Standard of Protection: The actual or design standard of protection afforded by a flood defence, whether formal or informal. Usually expressed as an Annual Exceedance Probability
SuDS	Sustainable Drainage Systems: Control measures designed to drain surface water in a more sustainable manner rather than conventional techniques such as drainage pipes / sewers.
Surface water	Any body of water that is not groundwater (for example rivers, estuaries, ponds etc) as well as temporary waters resulting from flooding, run-off etc.
WFD	The Water Framework Directive (2000/60/EC) ³ came into force in 2000. It was transposed into UK law in 2003 and it establishes a strategic framework for the management of the water environment with the aim of enhancing aquatic ecosystems, promoting the sustainable use of water and reducing water pollution.

³ EU Water Framework Directive (2000/60/EC)



Site Number	Site Reference Number.
Site Name	Site Name and general location within the Borough.
Grid Reference	Full National Grid Reference.
Size of Site (ha)	Site size in hectares.
Location Plan	A plan showing the location of the site and the immediate surroundings at 1:10,000 scale.
Type of development proposed / vulnerability classification	The anticipated type of development that is proposed within the site and its related vulnerability classification as identified in Table 2 of the Technical Guidance - Flood Risk and Minerals Policy (March 2012) to the National Planning Policy Framework (March 2012).
No. Of Dwellings Proposed	The anticipated number of dwellings on the site if residential or mixed development is proposed.
Rivers, watercourses and water bodies	A description of the water features within the site.
Description of Existing Flood Management Infrastructure (and condition)	An indication of whether there are any formal raised flood defences, storage areas or culverts within or adjacent to the site that may influence flood risk within the site. If information on the condition and design standard of the defence is available then this is also presented.
Existing Land use	A brief indication of the current land use at the site.
Topography	A brief indication of the lie of the land, with topographical levels where available.
Risk Assessment	The following sections identify the risk to the site from all sources of flooding, summarise the risks and present recommendations for the management of flood risk.
Flood Zone Map	A plan showing the current Environment Agency Flood Zone Map within the site.
Proportion in FZ1	An indication of the area and proportion of the site that lies in Flood Zone 1, which indicates those areas with a Low risk of flooding and an annual chance of fluvial or tidal flooding (discounting the presence of flood defences) of less than 0.1% in any one year. An annual chance of flooding of 0.1% in any given year is equivalent to flooding an average of once in every 1000 years.
Proportion in FZ2	An indication of the area and proportion of the site that lies in the Environment Agency's Flood Zone 2, which indicates those areas with a Moderate risk of flooding and an annual chance of fluvial flooding (discounting the presence of flood defences) of between 0.1% and 1% in any one year or an annual chance of tidal flooding (discounting the presence of flood defences) of between 0.1% and



	<p>no allowance for scour or erosion of the defence under such conditions.</p> <p>Where data is available then detailed mapping outputs are provided covering scenarios with a 5%, 1% and 1% plus an allowance for climate change, reflecting the Actual risk extents equivalent to 3a and 3b plus the effect of climate change on the extent of Flood Zone 3a. If data is available then information on flood depth, velocity and hazard is also presented for events with a 1% chance of occurring and with a 1% chance with an allowance for climate change.</p>
<p>Actual Flood Risk Map</p>	<p>If data is available, a plan is provided showing the modelled extent of the 5% AEP event (equivalent to Flood Zone 3b), the 1% AEP event (equivalent to Flood Zone 3a) and the 1% AEP event plus an allowance for climate change, which is the anticipated extent of Flood Zone 3a in approximately 100 years (2110).</p>
<p>Actual Flood Risk Depth Map</p>	<p>If data is available, a plan is provided showing the predicted depth of flooding in the 1% AEP event plus an allowance for climate change event in approximately 100 years (2110).</p>
<p>Actual Flood Risk Velocity Map</p>	<p>If data is available, a plan is provided showing the predicted velocity of flooding in the 1% AEP event plus an allowance for climate change event in approximately 100 years (2110).</p>
<p>Actual Flood Risk Hazard Map</p>	<p>If data is available, a plan is provided showing the predicted hazard (as defined in DEFRA Report FD2321¹) of flooding in the 1% AEP event plus an allowance for climate change event in approximately 100 years (2110).</p>
<p>Surface Water (Pluvial)</p>	<p>The Environment Agency's Flood Map for Surface Water (FMfSW) dataset is presented, showing the extent of flooding that would be anticipated from a 200-year storm and in which the depth of flooding exceeds 0.1m. Also indicated is the extent of those areas classified as 'deep', which is where flood depths may exceed 0.3m.</p>
<p>Groundwater</p>	<p>Mapping is provided to identify if the site lies within an area that is shown to be at risk within the Environment Agency's Areas Susceptible to Groundwater Flooding (ASStGWF) dataset. If the site was shown to lie within an area at risk of Groundwater Emergence from the Knowsley Level 1 SFRA then this is also identified.</p>
<p>Artificial Sources</p>	<p>An indication is provided of whether the site is shown to be at risk from reservoir flooding, as indicated within the Environment Agency's Reservoir Inundation Maps.</p> <p>If there is a potential risk from flooding from the canal network or other artificial sources of flooding then this is also identified.</p>

¹ DEFRA/Environment Agency FD2321/TR1 Report Flood Risks to People, March 2006.
http://randd.defra.gov.uk/Document.aspx?Document=FD2321_3437_TRP.pdf



Developable Area

A plan is provided that identifies the areas within the site that can be developed for different land use types and flood risk vulnerability. The areas defined are as follows:

- Very High Risk Areas – Water Compatible / Essential Infrastructure only
- High Risk Areas – Less Vulnerable development
- Moderate Risk Areas – More Vulnerable development
- Low Risk Areas – All types of development

The classification assumes that there is no requirement to pass the Exception Test, for example by locating More Vulnerable development within Flood Zone 3a. Each of the classes are based on the following data with the following justification:

Very High Risk Areas

- Flood Zone 3b (where available from detailed modelling) – On the basis that this is Functional Floodplain)
- Areas of Significant Hazard (where available from detailed modelling) – On the basis that the Environment Agency will object to development in areas shown to have a Significant – Hazard to Most classification.

High Risk Areas

- 1% AEP plus climate change extents (where available from detailed modelling) – As this defines the area of High Risk, equivalent to Flood Zone 3a) over the anticipated lifetime of a development
- Flood Zone 3a (where there is no detailed modelling available) – On the basis that this is the only available information on areas at High Risk
- Areas shown to flood to depths of greater than 0.3m by the Environment Agency's Flood Map for Surface Water (200yr-deep) dataset – On the basis that the Environment Agency's guidance considers this area to be a hazard to people and the probability of flooding and consequences in this area are equivalent to a High Risk from other sources

Moderate Risk Areas

- 0.1% AEP plus climate change extents (where available from detailed modelling) – As this defines the area of Moderate Risk, equivalent to Flood Zone 2)
- Flood Zone 2 (where there is no detailed modelling available) – On the basis that this is the only available information on areas at Moderate Risk

Low Risk Areas



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- All areas outside of the above within the development sites





Site Number	LDF7
Site Name	Land at Edenhurst Avenue, Huyton.
Existing Flood Management Infrastructure (and condition)	however, Court Hey Brook / Childwall Brook is identified as a privately maintained culverted channel with an approximate length of 3.2km and dimensions of 1.65m x 1.85m. Current condition is described as fair and the design standard is indicated as 1 in 5 years (20%). The culvert is considered to be a major flood defence asset.
Existing Land use	The existing site is predominantly Greenfield, the site is currently used as sports field.
Topography	The ground slopes in a south westerly direction towards Court Hey Brook / Childwall Brook. Levels in the north east are approximately 21.3m AOD sloping down to approximately 20.1m AOD.
Risk Assessment	
Flood Zone Map	
Proportion in FZ1	3.3ha (49%) in total.
Proportion in FZ2	3.5ha (51%) in total.
Proportion in FZ3a	3.1ha (46%) in total.
Proportion in FZ3b	No information on the extent of Flood Zone 3b is available.
Actual Flood Risk	The only hydraulic modelling of Childwall Brook is a 1 dimensional JFLOW model that was undertaken to review and challenge earlier



Site Number

LDF7

Site Name

Land at Edenhurst Avenue, Huyton.

versions of the Flood Zone Map.

Flood outlines are available for the 1% AEP event and the 1% AEP event plus climate change. These are presented in the maps below, including flood depths for the 1% AEP event and the 1% AEP event plus climate change.

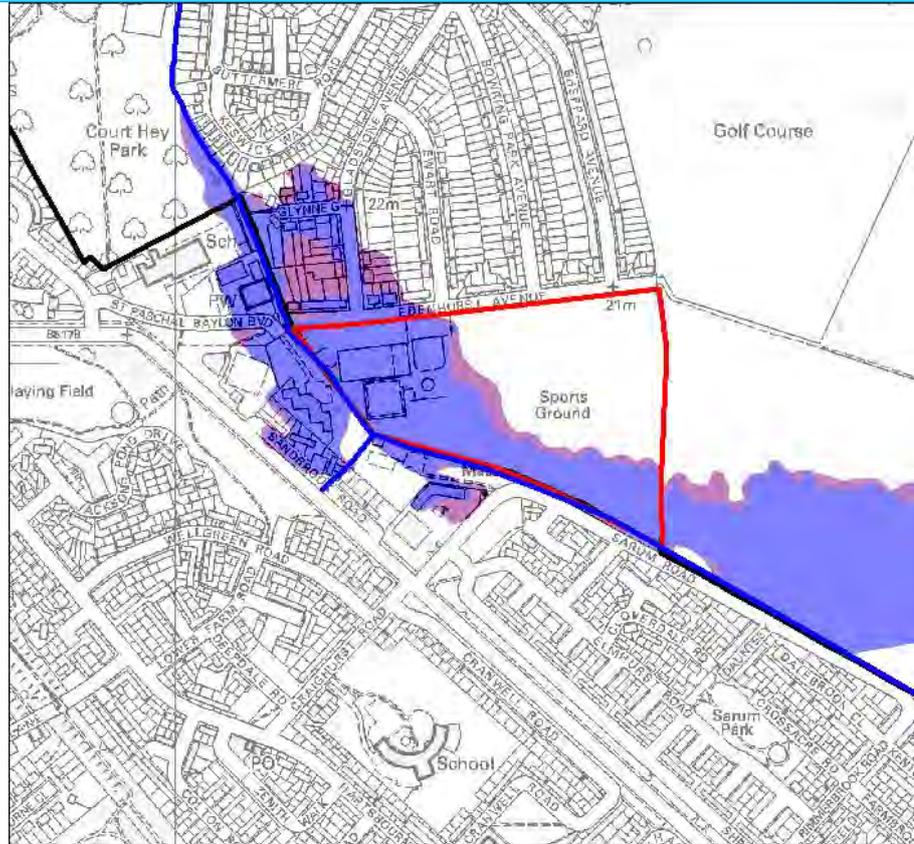
No modelling is available for the 20% AEP event and the model cannot be re-run to obtain this information.

The flood extents from this modelling were used to redefine the flood zones and are therefore the same as those in the Environment Agency's current Flood Zone Map. No information is available in mappable form on velocity or hazard.

The 1% AEP plus climate change event within the site is the same as the 0.1% AEP flood extent.

Actual Flood Risk Map

-  KMBC Boundary
-  Site Boundary
-  Watercourse
-  1% AEP
-  1% AEP plus climate change





Site Number

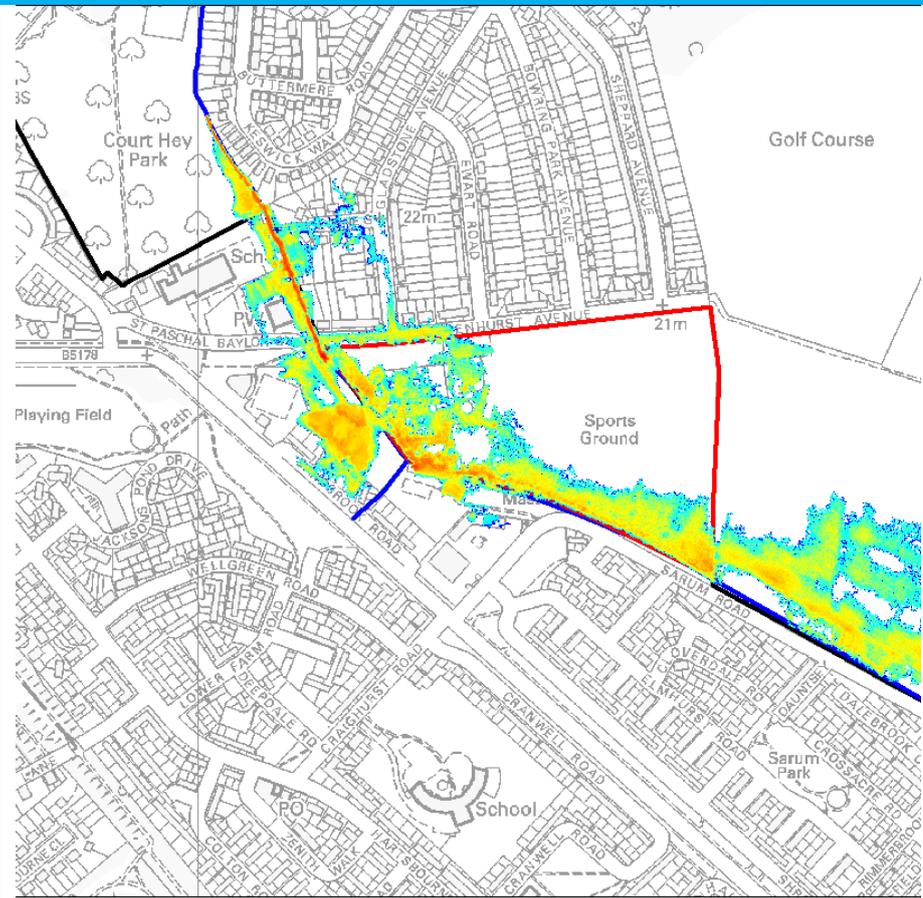
LDF7

Site Name

Land at Edenhurst Avenue, Huyton.

Depth 1% AEP event

-  KMBC Boundary
-  Site Boundary
-  Watercourse
-  > 0.015m
-  0.015m to 0.03m
-  0.03m to 0.7m
-  0.7m to 2.5m
-  >2.5m





Site Number

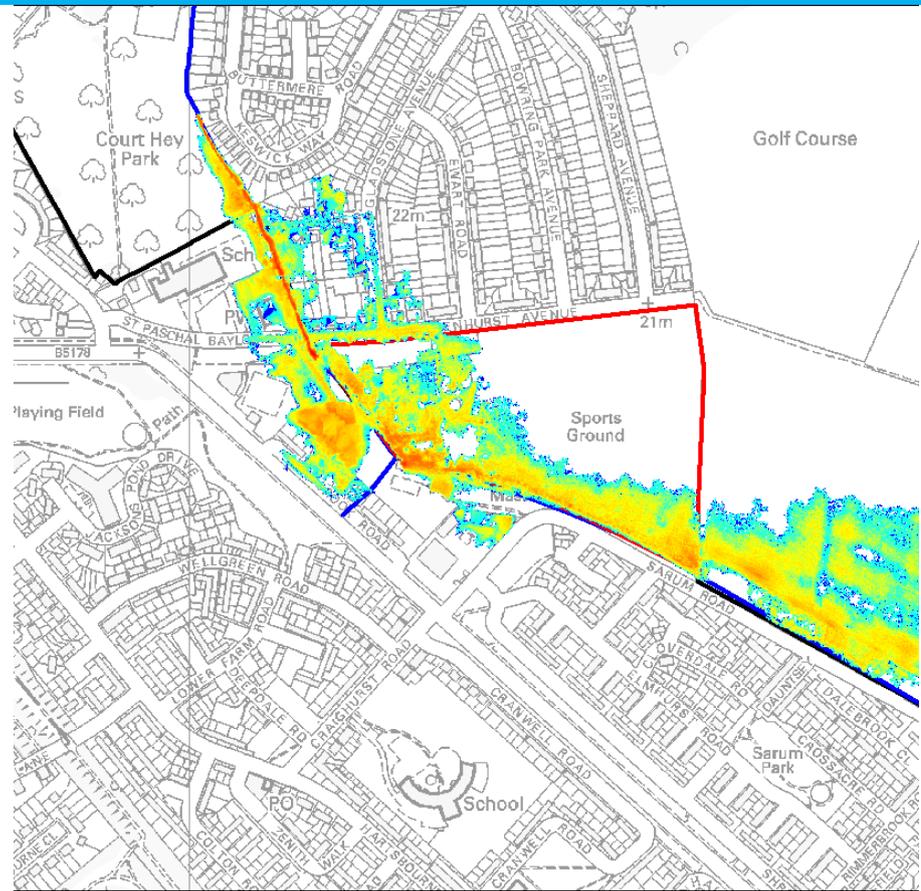
LDF7

Site Name

Land at Edenhurst Avenue, Huyton.

Depth 1% AEP plus climate change

-  KMBC Boundary
-  Site Boundary
-  Watercourse
-  > 0.015m
-  0.015m to 0.03m
-  0.03m to 0.7m
-  0.7m to 2.5m
-  >2.5m







Site Number

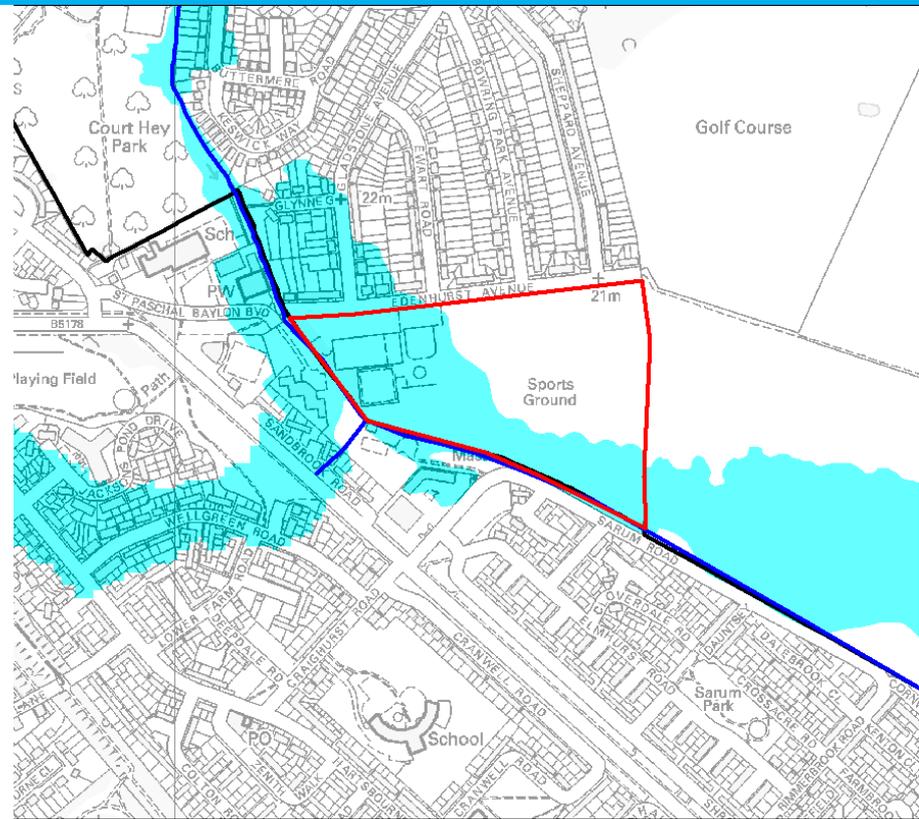
LDF7

Site Name

Land at Edenhurst Avenue, Huyton.

Residual Flood Risk Map

-  KMBC Boundary
-  Site Boundary
-  Watercourse
-  0.1% AEP



Summary of Risk

A significant proportion of the site is within Flood Zone 3 and Fluvial Flood Zone 2 and this was defined by more detailed analysis that included assessment of the culvert through which Court Hey Brook / Childwall Brook flows.

The modelling did not consider the 5% event but does provide detail of the 1% AEP event (3.1ha), 1% plus climate change (3.5ha) and 0.1% AEP events (also 3.5ha).

The Environment Agency's National Flood and Coastal Defence Database (NFCDD) data indicates that the capacity of the Court Hey Brook / Childwall Brook culvert is equivalent to a 20% AEP event (1 in 5 years). It is therefore possible that there would be flooding within the lower lying areas of the site along the path of the culverted watercourse (see Surface Water Flood Map for indicative areas) and that the site may be sensitive to blockage.

Given the remaining uncertainty over the extent of the 5% AEP event (Flood Zone 3b) there may remain potential constraints to development along any overland flow path that exists through the site.

There is a relatively minor risk from surface water flooding across









Site Number

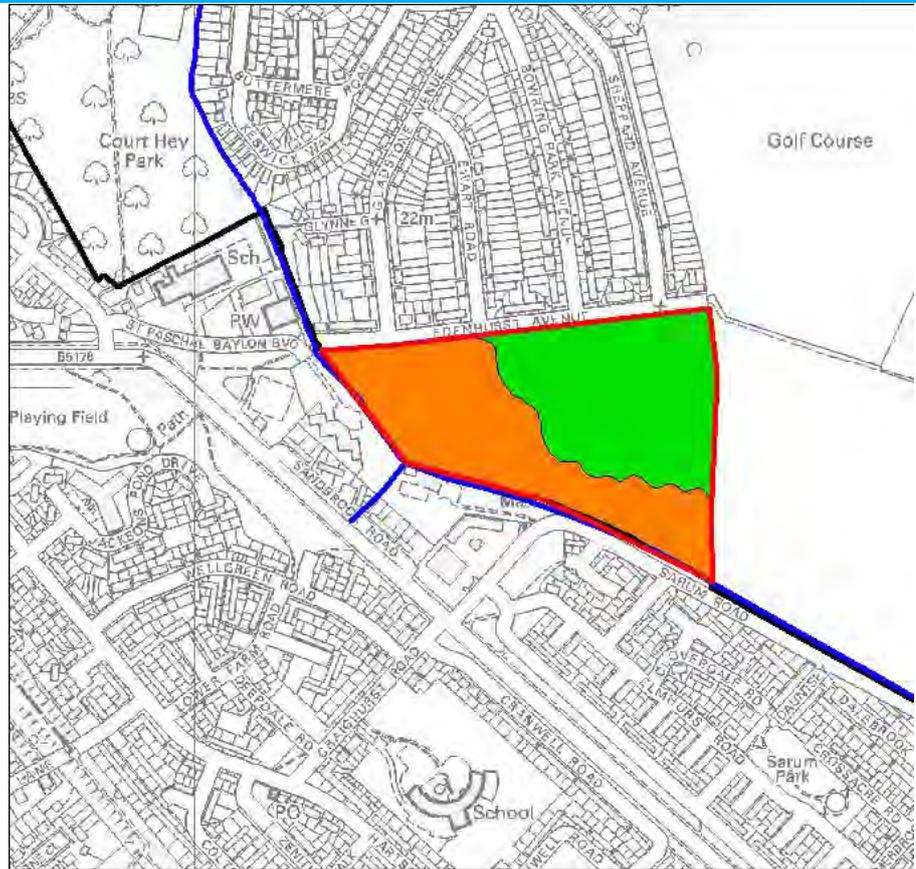
LDF7

Site Name

Land at Edenhurst Avenue, Huyton.

Developable Areas

-  KMBC Boundary
-  Site Boundary
-  Watercourse
-  Low Risk - All Types
-  Moderate Risk – More Vulnerable
-  High Risk – Less Vulnerable
-  V High Risk – Water Comp / Ess. Inf.





Site Number	LDF11
Site Name	Land at Greensbridge Lane, Halewood
Grid Reference	345740 386080
Location Plan	
Size of Site (ha)	33.77ha
Type of development proposed / vulnerability classification	Housing / More Vulnerable Land Use
No. Of Dwellings Proposed	270 Properties
Rivers, watercourses and water bodies	<p>The site consists of two parcels of land, split by Netherley Brook. The smaller northern parcel is bound by Netherley Brook to the south west, Cartbridge Lane to the north and Greensbridge Lane to the east. The larger southern parcel is bound by Netherley Brook to the north east, with Greensbridge Lane and Bailey's Lane to the north west, Lower Road to the south west and a railway line to the south east.</p> <p>At the very northern tip of the site lies the confluence of Netherley Brook, and Halewood Brook, which drain land to the north, and</p>



Site Number	LDF11
Site Name	Land at Greensbridge Lane, Halewood
	<p>Woodend Brook, which runs alongside Cartbridge lane and which drains land to the north and west of Halewood Village.</p> <p>There are two field drains shown within the site that flow to the north east. The southern one of these appears larger and is shown to connect to Netherley Brook. A small pond (approximately 0.05ha) is the source of the northern smaller drain. A larger pond (approximately 1ha) lies immediately south of the small pond to the centre of the southern boundary.</p> <p>Downstream of the railway line on the southern boundary, Netherley Brook becomes Ditton Brook.</p>
Description of Existing Flood Management Infrastructure (and condition)	<p>There are privately maintained raised flood embankments on Netherley Brook on the left and right banks through parts, but not all, of the larger parcel of land within the site. The embankments extend from a point approximately 200m north of the railway bridge to Greensbridge Lane. Above and below this reach there are no raised defences, only a privately maintained channel.</p> <p>The NFCDD data states that the condition of this embankment is Very Poor (5) but no target condition has been set. The Standard of Protection is 5 years. The embankments are shown to overtop during the 5% (20yr) AEP event. Despite the poor condition and low Standard of Protection, the defences are considered to be major flood defence assets.</p> <p>Downstream of the railway line there are Environment Agency maintained defences on the right bank of what becomes Ditton Brook and privately maintained defences on the left bank. The Standard of Protection provided by these defences are 100 years and 5 years respectively and the condition of both is Very Poor.</p>
Existing Land use	Predominantly Greenfield with Lawfords Boarding Kennels.
Topography	The ground slopes in a northerly direction towards Netherley Brook, where ground levels are approximately 6-7m AOD.
Risk Assessment	



Site Number

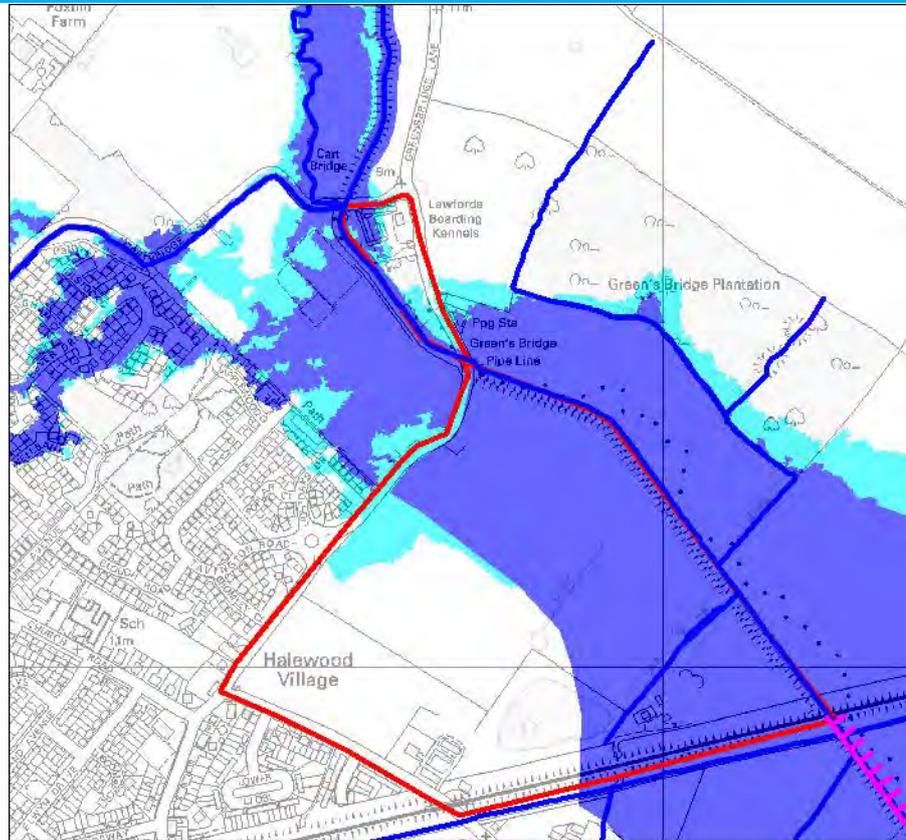
LDF11

Site Name

Land at Greensbridge Lane, Halewood

Flood Zone Map

-  Site Boundary
-  Watercourse
-  EA Flood Defences
-  Flood Zone 3
-  Flood Zone 2



Proportion in FZ1

12.95ha (38%) in total.

Proportion in FZ2

20.82ha (62%) in total.

Proportion in FZ3a

15.89ha (47%) in total.

Proportion in FZ3b

3.15ha (9%) in total (from detailed modelling).

Actual Flood Risk

Hydraulic modelling of the Netherley Brook and Halewood Brook shows flooding adjacent to defences in the 5% AEP event (equivalent to Flood Zone 3b, Functional Floodplain) within the site larger parcel of land but no impact on the smaller parcel of land. This is likely to be due to overtopping of the flood embankment which only offers a relatively low Standard of Protection (5 years). There may also be a contribution from flow backing up behind the brick arch railway bridge immediately downstream.

Flooding is shown to extend across the site during the 1% plus climate AEP event as a result of overtopping of the channel at the confluence of the Halewood, Netherley and Woodend Brooks. Note that detailed modelling was carried out for the fluvial zones only. Flooding is likely to get worse on site as the effects of climate change are realised and the current Standard of Protection is likely to



Site Number

LDF11

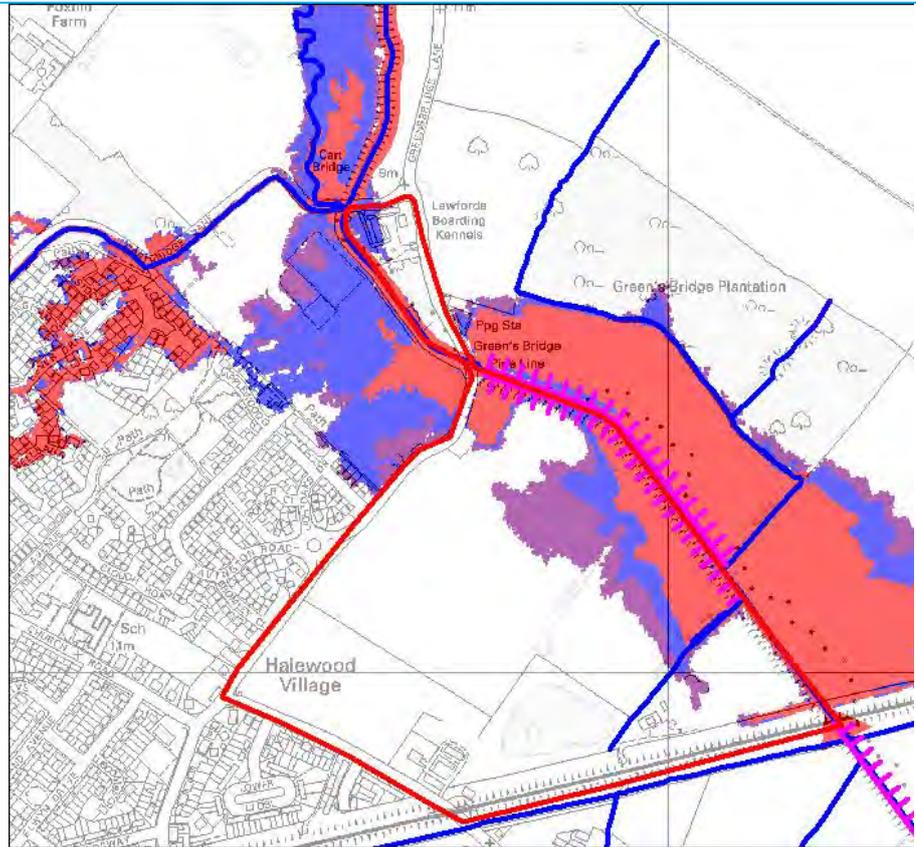
Site Name

Land at Greensbridge Lane, Halewood

decrease over time.

Actual Flood Risk Map

-  Site Boundary
-  Watercourse
-  Raised Flood Defences
-  5% AEP
-  1% AEP
-  1% AEP plus climate change





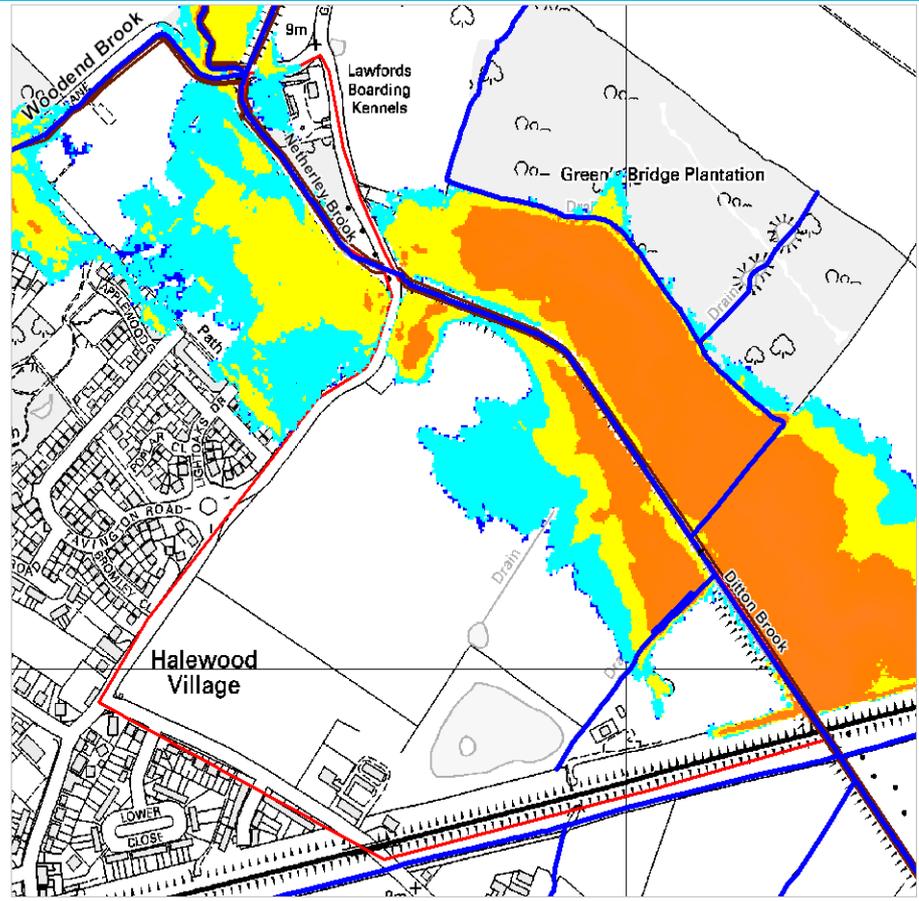
Site Number

LDF11

Site Name

Land at Greensbridge Lane, Halewood

Depth 1% AEP event
plus climate change





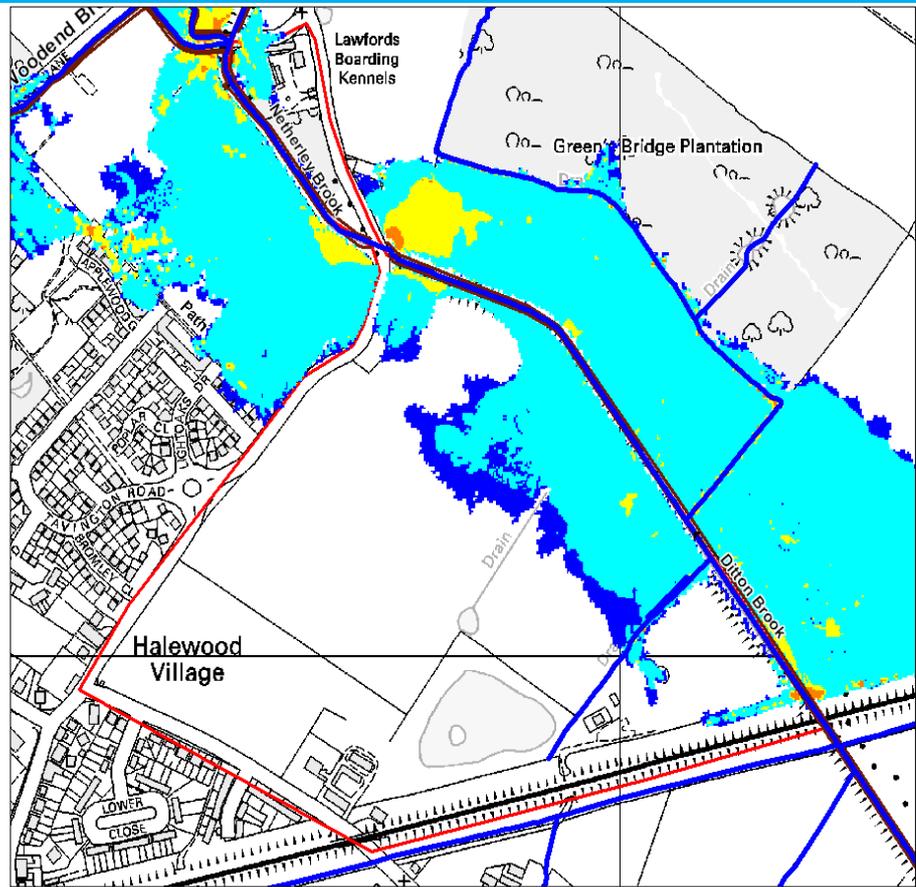
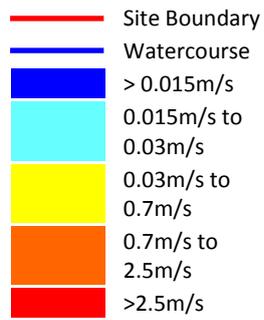
Site Number

LDF11

Site Name

Land at Greensbridge Lane, Halewood

**Velocity 1% AEP plus
climate change**





Site Number

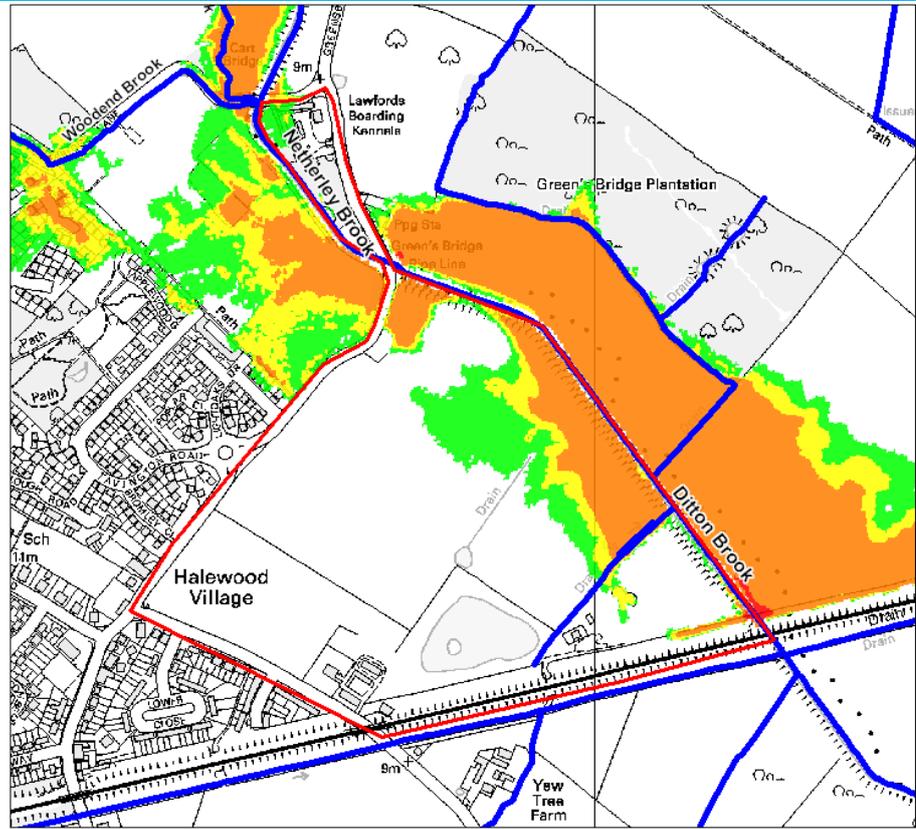
LDF11

Site Name

Land at Greensbridge Lane, Halewood

**Hazard 1% AEP plus
climate change**

-  Site Boundary
-  Watercourse
-  Low
-  Moderate
-  Significant
-  Extreme







Site Number

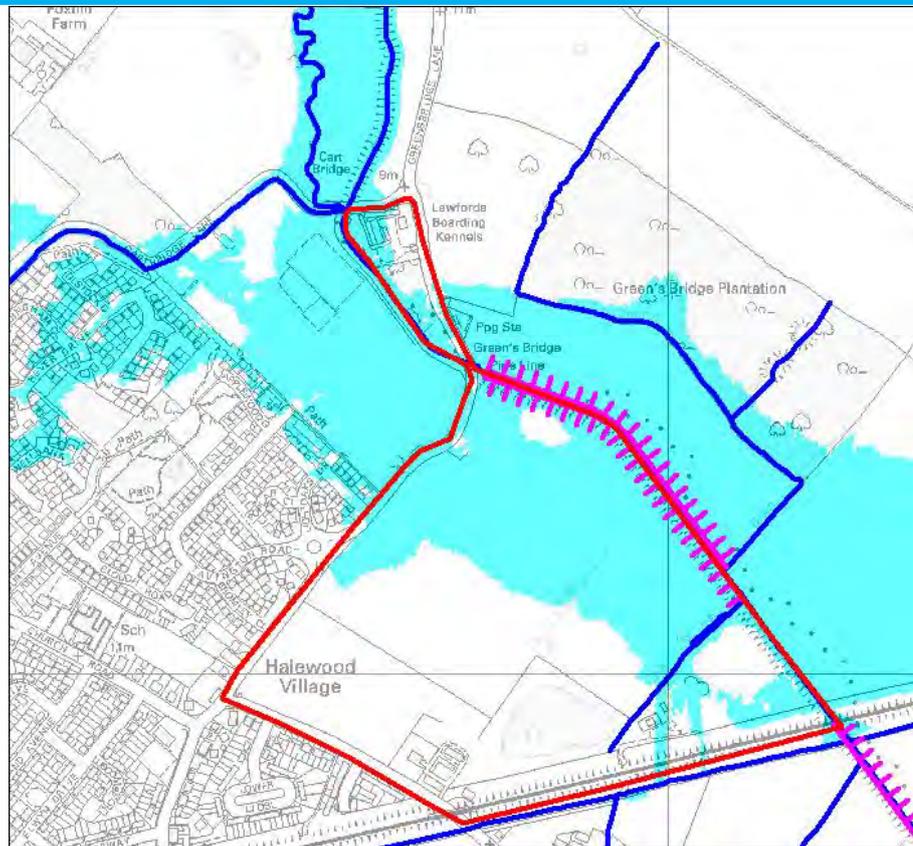
LDF11

Site Name

Land at Greensbridge Lane, Halewood

Residual Flood Risk Map

-  Site Boundary
-  Watercourse
-  Raised Flood Defences
-  0.1% AEP



Summary of Risk

A large proportion of the site is within the Environment Agency's Flood Zone 3 and Flood Zone 2.

More detailed modelling shows that significant parts of the site are at risk during the 5% AEP fluvial event (the Functional Flood Plain) and also during the 1% (approximately 5ha) and 0.1% AEP flood events. The outline of the 5% AEP event is relatively extensive along Netherley Brook and this will be a constraint to development, as only water compatible land uses and essential infrastructure would be permitted within this zone.

There is a risk from surface water flooding across the site, although indicated depths suggest that the majority would not be considered a significant constraint and the consequences could be managed. There may, however, be areas of deeper water that could be a constraint to development.

The area is not shown to lie in an area susceptible to groundwater flooding. However, the site is shown to be located in a Groundwater Source Protection Zone 1, (SPZ). Consultation should be held with the Environment Agency to determine their policy position in relation to infiltration-based SuDS. SPZs are established to protect









Site Number

LDF11

Site Name

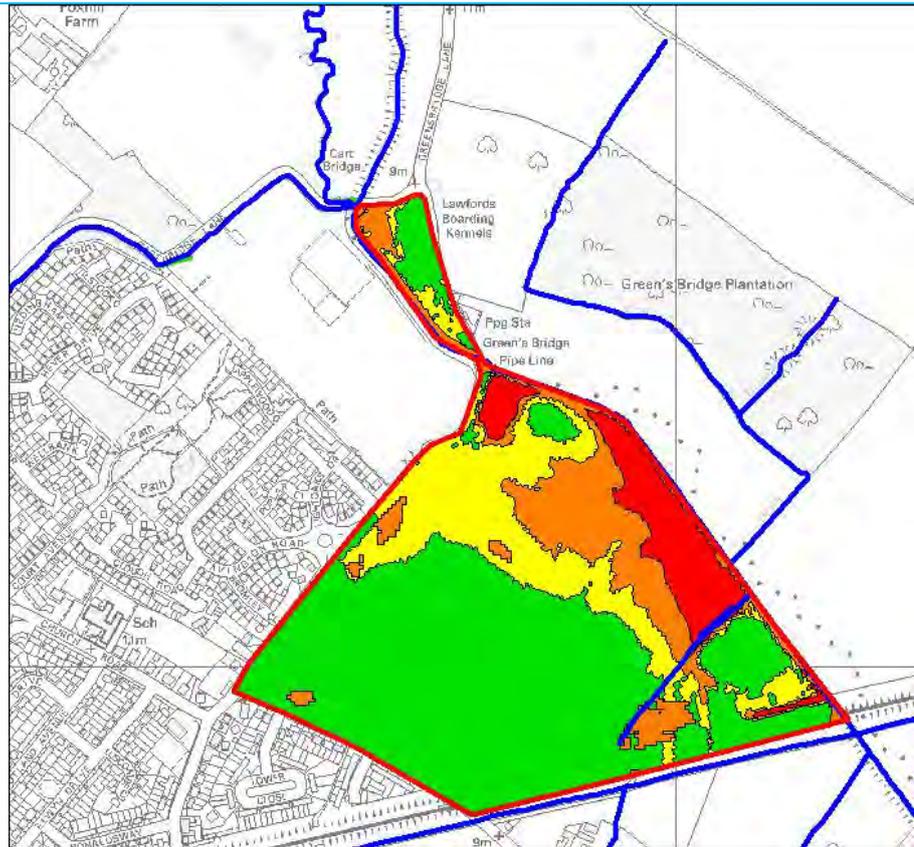
Land at Greensbridge Lane, Halewood

raised embankment.

The emerging Local Plan suggests that the site could accommodate 270 properties, however without mitigation the developable area amounts to only 73% of the site area.

Developable Areas

-  Site Boundary
-  Watercourse
-  Low Risk - All Types
-  Moderate Risk – More Vulnerable
-  High Risk – Less Vulnerable
-  V High Risk – Water Comp / Ess. Inf.







Site Number	E41
Site Name	Adjacent to BASF Coatings and Inks Ltd, Ellis Ashton Street, Huyton
condition)	(along the southern boundary of the site) upstream to the footpath north east of Huyton Business Park. The NFCDD data states that the condition of the channel is fair (3), with the Standard of Protection is quoted as 5 years.
Existing Land use	Greenfield site.
Topography	The site slopes from north to south, ground levels in the north are approximately 28m AOD, decreasing to 26m AOD along Ellis Ashton Street.
Risk Assessment	
Flood Zone Map	<p> — Site Boundary — Watercourse Flood Zone 3 Flood Zone 2 </p>
Proportion in FZ1	0.886ha (97%) in total
Proportion in FZ2	0.024ha (3%) in total
Proportion in FZ3a	0.015ha (2%) in total
Proportion in FZ3b	0.001ha (0.1%) in total (from detailed modelling).
Actual Flood Risk	Hydraulic modelling of the Logwood Mill Brook has refined the Flood Zones in comparison to the Environment Agency's Flood Map for the site. Only a very small area on the right bank of the Brook is shown to be within the 5% AEP (1 in 20 year) flood extent, which is unlikely to be a significant constraint to development.



Site Number

E41

Site Name

Adjacent to BASF Coatings and Inks Ltd, Ellis Ashton Street, Huyton

There is flooding within the site during the 1% plus climate change AEP, however it is predominantly follows the alignment of the channel and does not encroach on the site significantly. Depths of flooding are indicated to be up to 0.4m.

Actual Flood Risk Map

-  Site Boundary
-  Watercourse
-  5% AEP
-  1% AEP
-  1% AEP plus climate change





Site Number

E41

Site Name

Adjacent to BASF Coatings and Inks Ltd, Ellis Ashton Street, Huyton

**Depth 1% AEP event
plus climate change**





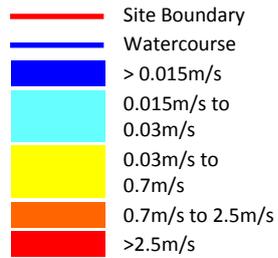
Site Number

E41

Site Name

Adjacent to BASF Coatings and Inks Ltd, Ellis Ashton Street, Huyton

Velocity 1% AEP plus climate change





Site Number

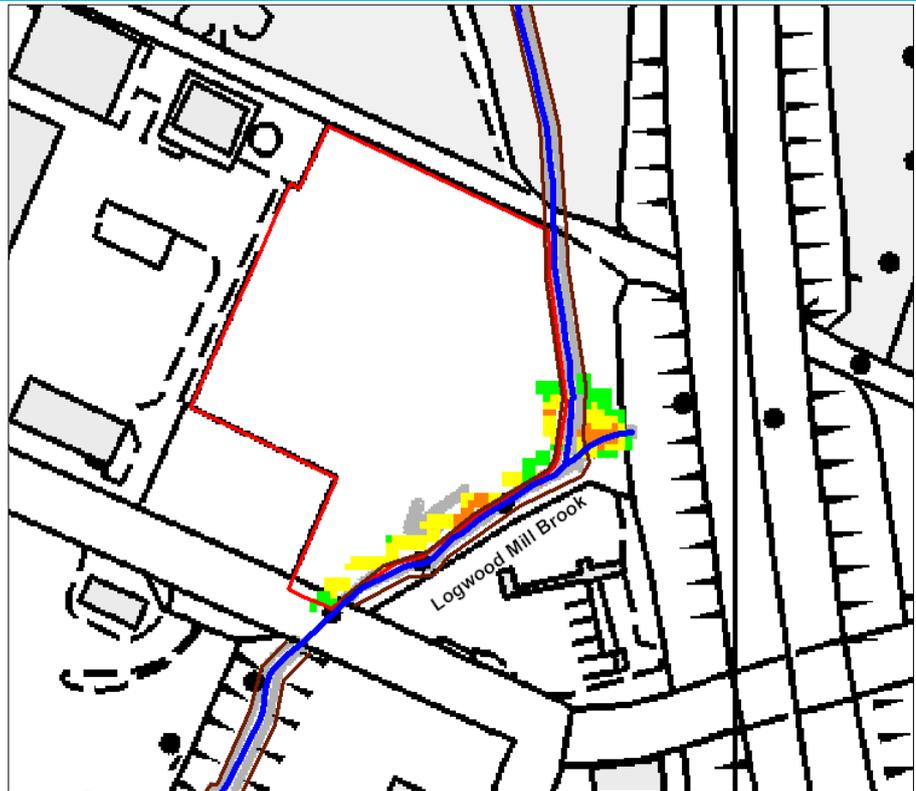
E41

Site Name

Adjacent to BASF Coatings and Inks Ltd, Ellis Ashton Street, Huyton

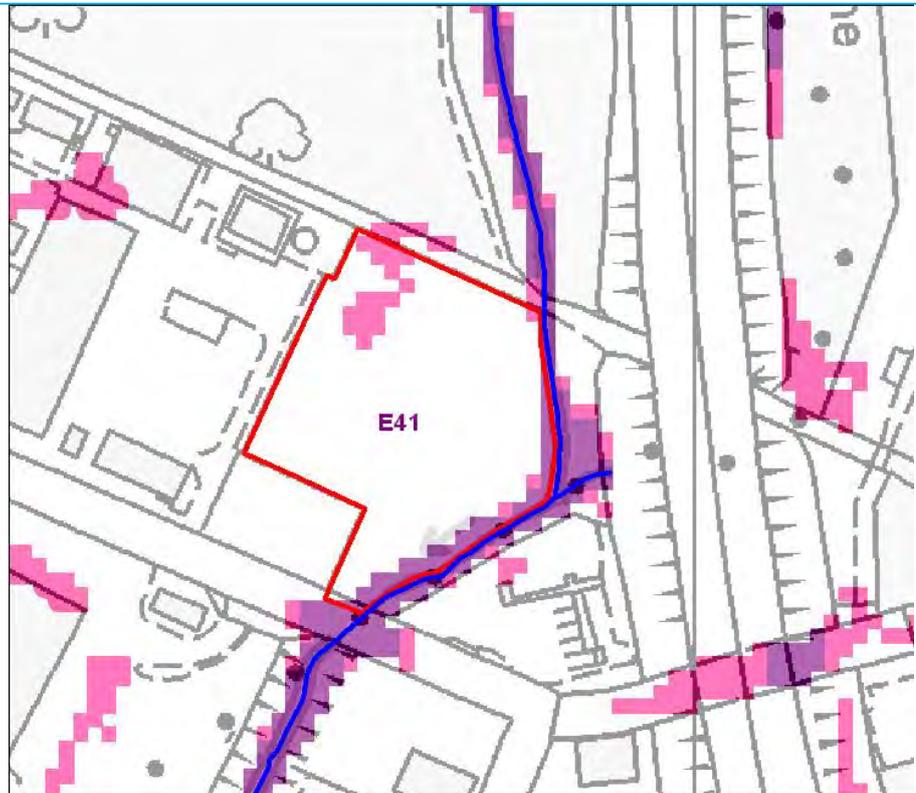
Hazard 1% AEP plus climate change

-  Site Boundary
-  Watercourse
-  Low
-  Moderate
-  Significant
-  Extreme



Surface Water (Pluvial)

-  Site Boundary
-  Watercourse
-  FMfSW 200yr deep
-  FMfSW 200yr











Site Number

E41

Site Name

Adjacent to BASF Coatings and Inks Ltd, Ellis Ashton Street, Huyton

Developable Areas

-  Site Boundary
-  Watercourse
-  Low Risk - All Types
-  Moderate Risk – More Vulnerable
-  High Risk – Less Vulnerable
-  V High Risk – Water Comp / Ess. Inf.











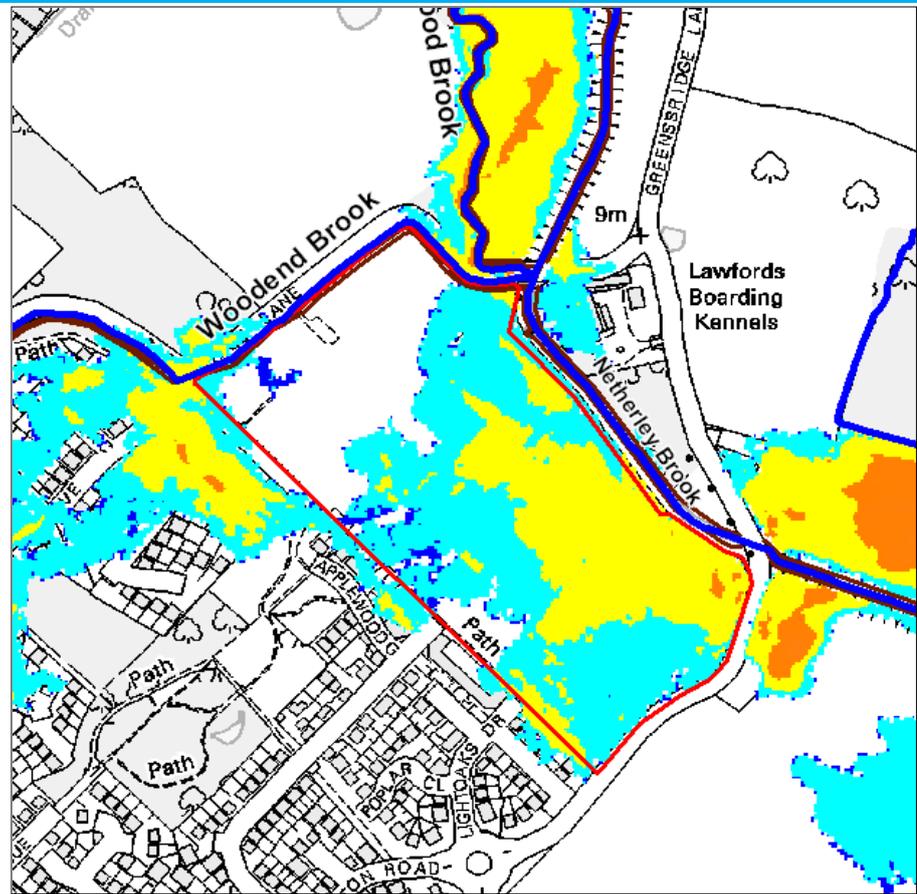
Site Number

H1

Site Name

Former Bridgefield Forum Site, Cartbridge Lane, Halewood

Depth 1% AEP event
plus climate change





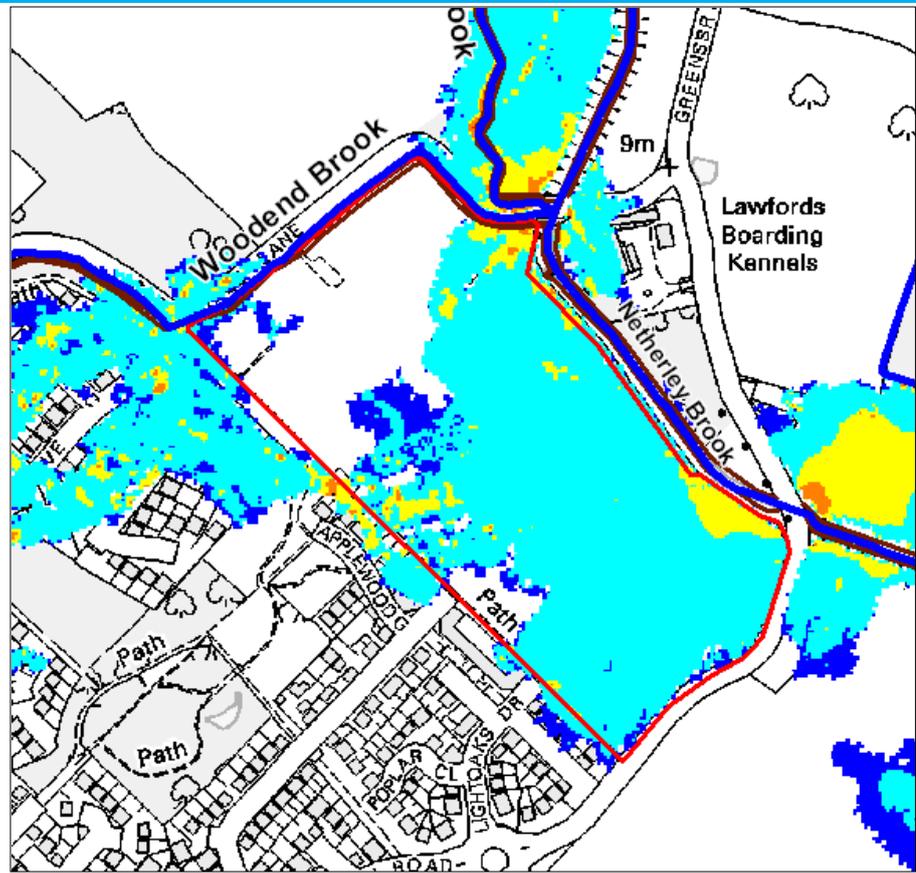
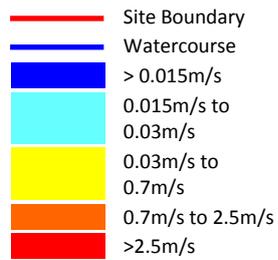
Site Number

H1

Site Name

Former Bridgefield Forum Site, Cartbridge Lane, Halewood

**Velocity 1% AEP plus
climate change**





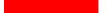
Site Number

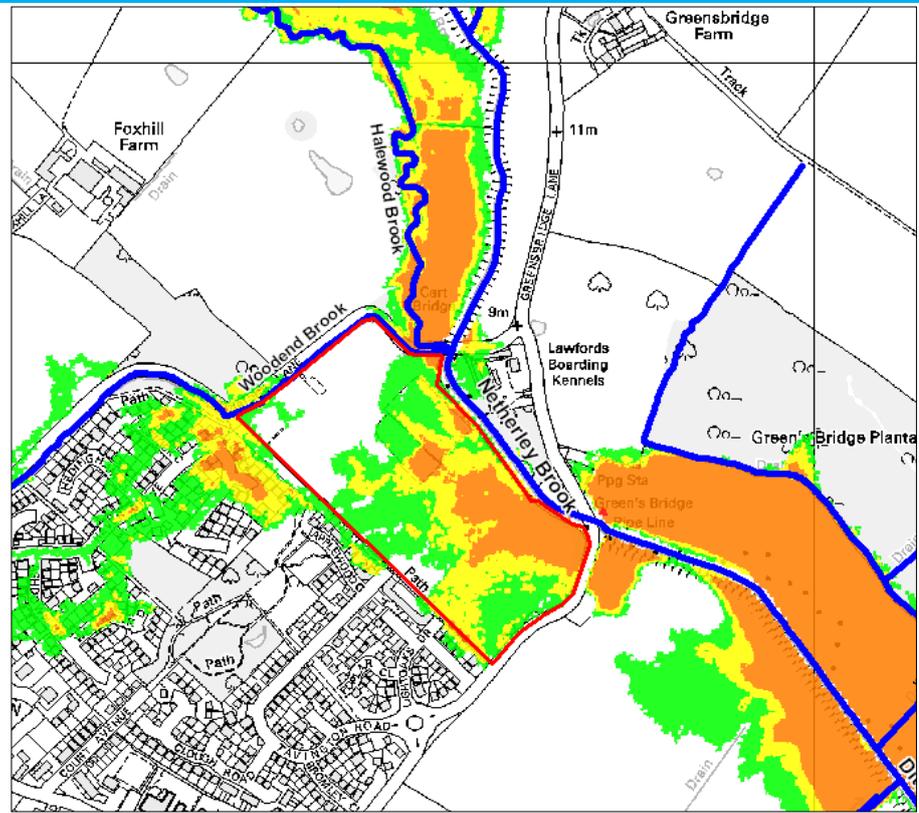
H1

Site Name

Former Bridgefield Forum Site, Cartbridge Lane, Halewood

Hazard 1% AEP plus
climate change

-  Site Boundary
-  Watercourse
-  Low
-  Moderate
-  Significant
-  Extreme







Site Number

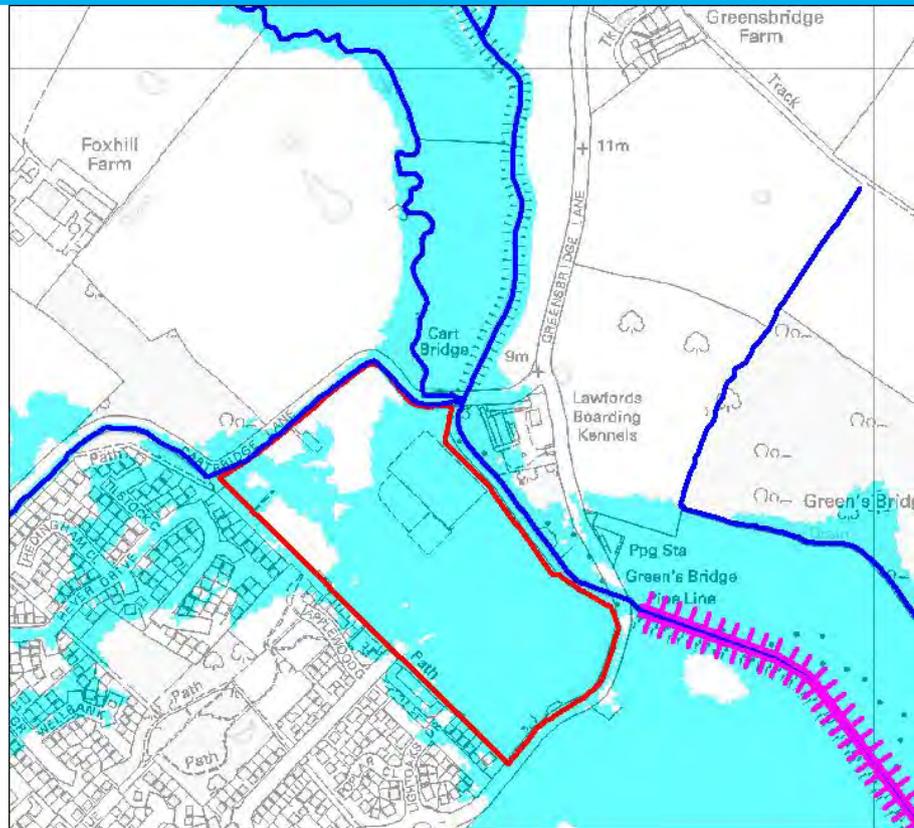
H1

Site Name

Former Bridgefield Forum Site, Cartbridge Lane, Halewood

Residual Flood Risk Map

-  Site Boundary
-  Watercourse
-  0.1% AEP



Summary of Risk

A large proportion of the site is located within the Environment Agency Flood Zone 2 and 3.

More detailed modelling shows that the site is at risk during the 5% AEP fluvial event (the Functional Flood Plain) and also during larger flood events. The extent of the 5% AEP event is predominately confined to an area in the eastern corner of the site close to Greensbridge Lane, however, the 1% AEP event plus climate change is extensive and without mitigation development should avoid this area.

There is a risk from surface water flooding across the site, although indicated depths suggest that it would not be considered a significant constraint and the consequences could be managed. Depths of flooding on site are predicted to be between 0.1m and 0.3m deep, with only a very small area in the centre of the site predicted to have flooding greater than 0.3m deep.

The site is not located in area identified to be susceptible to groundwater flooding. However, the site is shown to be located in a Groundwater Source Protection Zone 1, (SPZ). Consultation should be held with the Environment Agency to determine their policy









Site Number

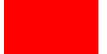
H1

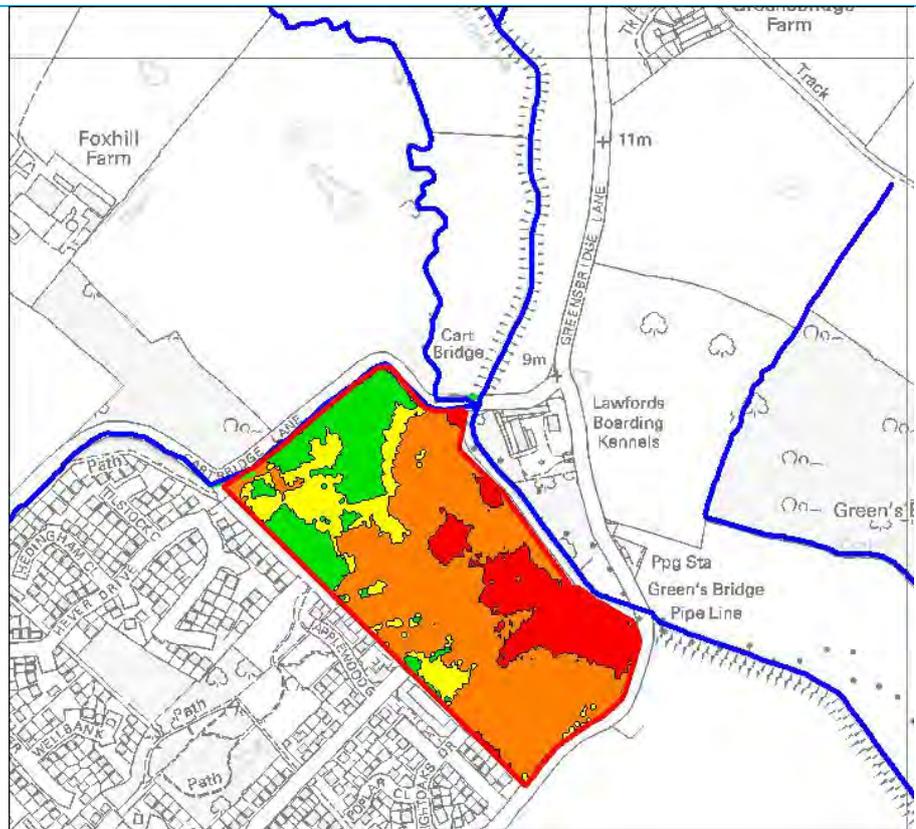
Site Name

Former Bridgefield Forum Site, Cartbridge Lane, Halewood

Flood Zone 3b or those with a Significant hazard and management measures within the site such as balancing ground raising with compensatory storage be used to maximise the developable area and to maximise the protection to development whilst not increasing flood risk elsewhere. Resilience and resistance measures are recommended for the management of residual risks, flood warning measures will be required and an evacuation plan prepared and provide to occupiers.

Developable Areas

-  Site Boundary
-  Watercourse
-  Low Risk - All Types
-  Moderate Risk – More Vulnerable
-  High Risk – Less Vulnerable
-  V High Risk – Water Comp / Ess. Inf.





Site Number

LDF19

Site Name

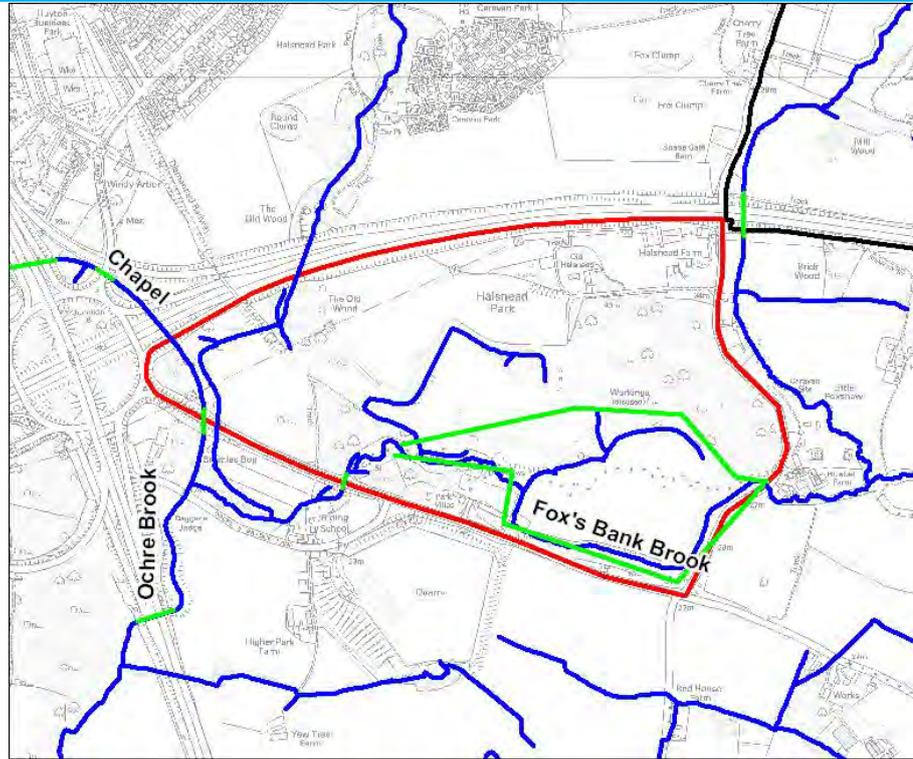
Cronton Colliery

Grid Reference

346650 388730

Location Plan

-  KMBC Boundary
-  Site Boundary
-  Watercourse



Size of Site (ha)

75.5ha

Type of development proposed / vulnerability classification

Employment / less vulnerable

No. Of Dwellings Proposed

Rivers, watercourses and water bodies

The water environment is understandably complex within this site. Chapel Brook, a section of Logwood Mill Brook / Prescott Brook, passes through the western end of the site before leaving via a culvert beneath the A5080.

Just to the east of Chapel Brook, a series of drains pass through the site from north to south. They connect a lake called Big Water and other ponds to the north of the M62 to Fox's Bank Brook. These drains should be connected via culverts within the site and should pass through a culvert beneath the A5080, however, there is no information on the precise location, size or condition of these structures.







Site Number

LDF19

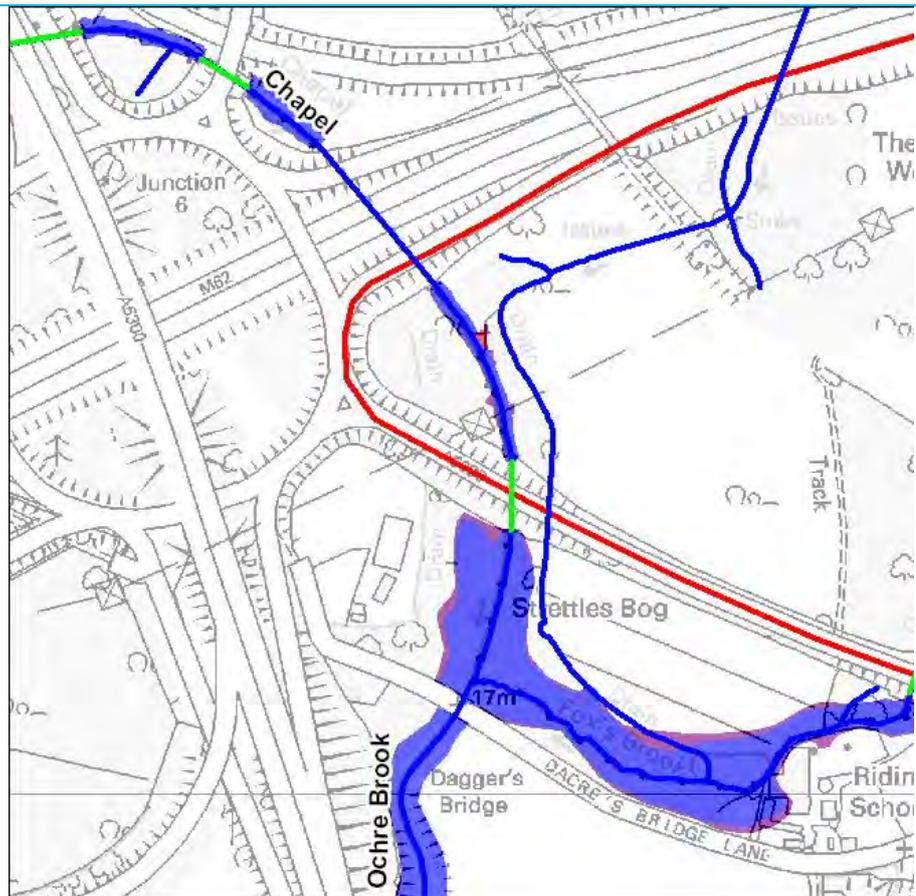
Site Name

Cronton Colliery

Given the extent of the flood zones in the area, it is likely that future development proposals would need to be informed by a site specific hydraulic model of the area. This would include detailed modelling of the Fox's Bank Brook, Logwood Mill Brook, the drains and the culverted watercourse.

Actual Flood Risk Map

-  Site Boundary
-  Watercourse
-  Culverted Channel
-  5% AEP
-  1% AEP
-  1% AEP plus climate change



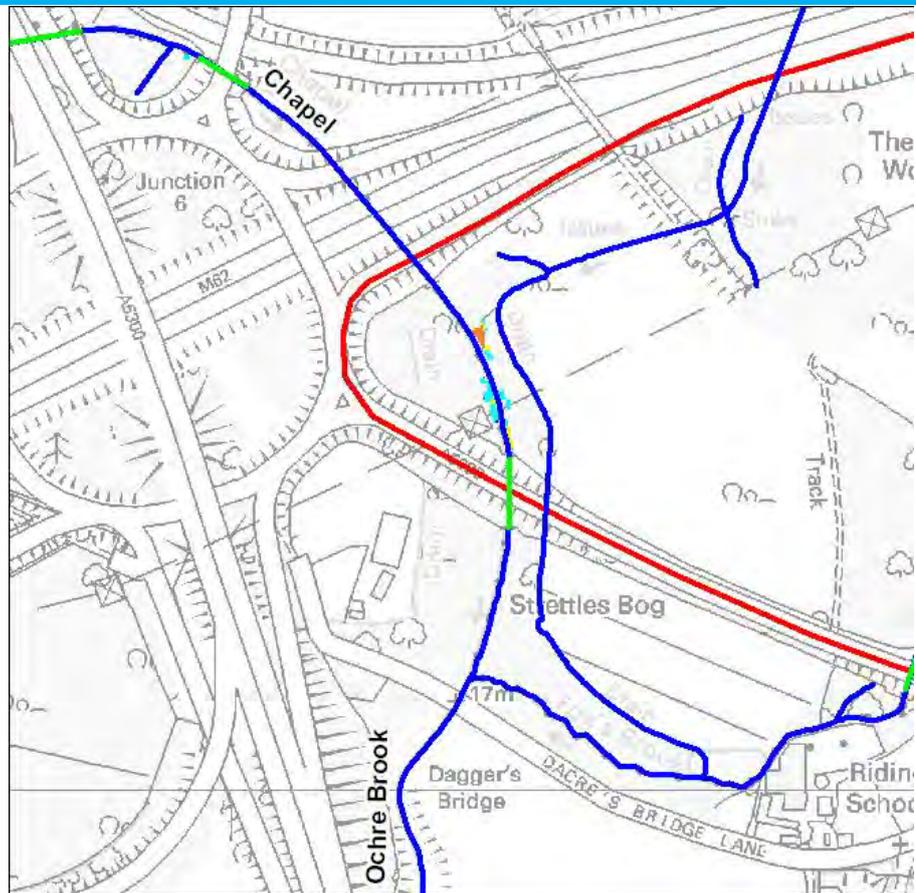


Site Number LDF19

Site Name Cronton Colliery

Depth 1% AEP event plus climate change

-  Site Boundary
-  Watercourse
-  Culverted Channel
-  > 0.015m
-  0.015m to 0.03m
-  0.03m to 0.7m
-  0.7m to 2.5m
-  >2.5m



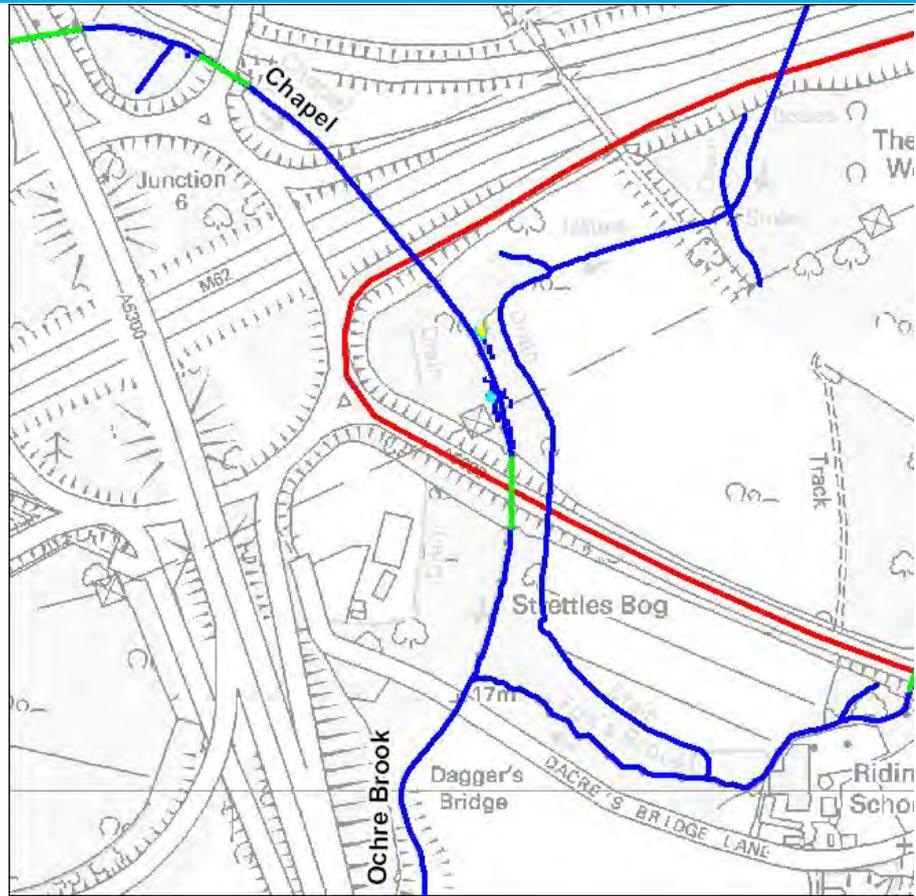


Site Number LDF19

Site Name Cronton Colliery

Velocity 1% AEP plus climate change

-  Site Boundary
-  Watercourse
-  Culverted Channel
-  > 0.015m/s
-  0.015m/s to 0.03m/s
-  0.03m/s to 0.7m/s
-  0.7m/s to 2.5m/s
-  >2.5m/s







Site Number

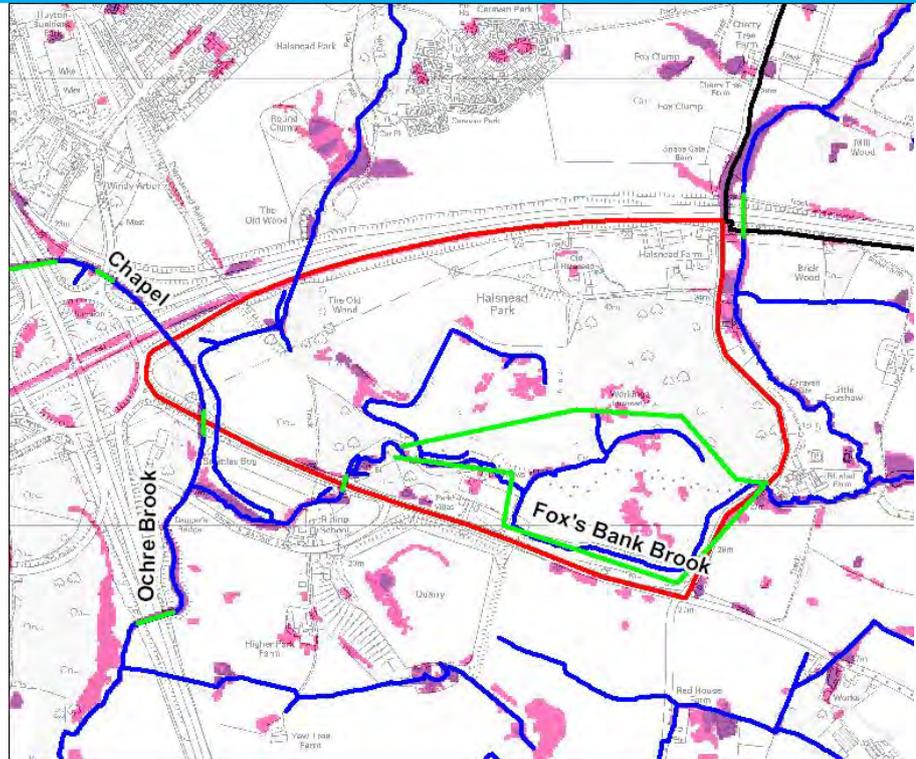
LDF19

Site Name

Cronton Colliery

Surface Water (Pluvial) Map

- KMBC Boundary
- Site Boundary
- Watercourse
- Culverted Channel
- FMfSW 200yr deep
- FMfSW 200yr



Groundwater

According to the EA groundwater susceptibility map, the site resides in a series of 1km squares where the proportion of each 1km square that is susceptible to groundwater flooding is 25% for the majority of the centre and the eastern part of the site and increase to 25%-50% for the western part of the site.

Artificial Sources

The site is not located in area shown to be at risk from reservoir flooding.

Residual Risk

Detailed modelling of the Logwood Mill Brook for the 0.1% AEP event shows out of bank flooding along the Brook with depths predicted to be up to 0.8m. However, it is broadly in line with the channel and therefore does not encroach on the site significantly.



Site Number

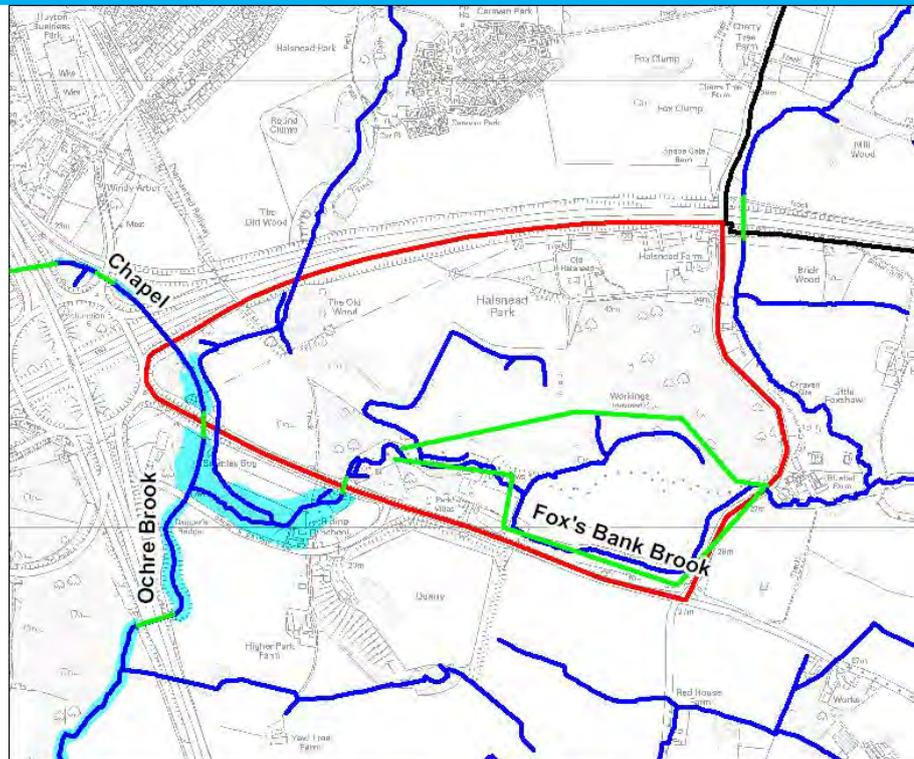
LDF19

Site Name

Cronton Colliery

Residual Flood Risk Map

-  KMBC Boundary
-  Site Boundary
-  Watercourse
-  Culverted Channel
-  0.1% AEP



Summary of Risk

The site is predominantly located within Flood Zone 1, with Flood Zone 2 and 3 associated with the Fox's Bank Brook along the southern boundary of the site and the Logwood Mill Brook along the western boundary. There is detailed hydraulic modelling available for Chapel Brook but not for the Fox's Bank Brook or indeed for any of the other watercourses on site. There are no formal defences on site, and the Fox's Bank Brook is partly in culvert for its course in the site.

More detailed modelling of the Chapel Brook indicates there is out of bank flooding during the 1% plus climate change AEP event. However, it is largely contained within the channel envelope. Flooding is more extensive either side of the channel for the 0.1% AEP event.

The lack of detailed modelling for Fox's Bank Brook requires the use of Flood Zones to assess the risk from this watercourse, however, a visual inspection indicates that they may not match the true nature of flooding in this location and as such are suspect.

The presence of culverts on most watercourses indicates a residual risk of blockage that should be taken into account.

Overall the site is low risk of surface water flooding; there are pockets of ponding across the site for the 0.5% AEP event, however









Site Number

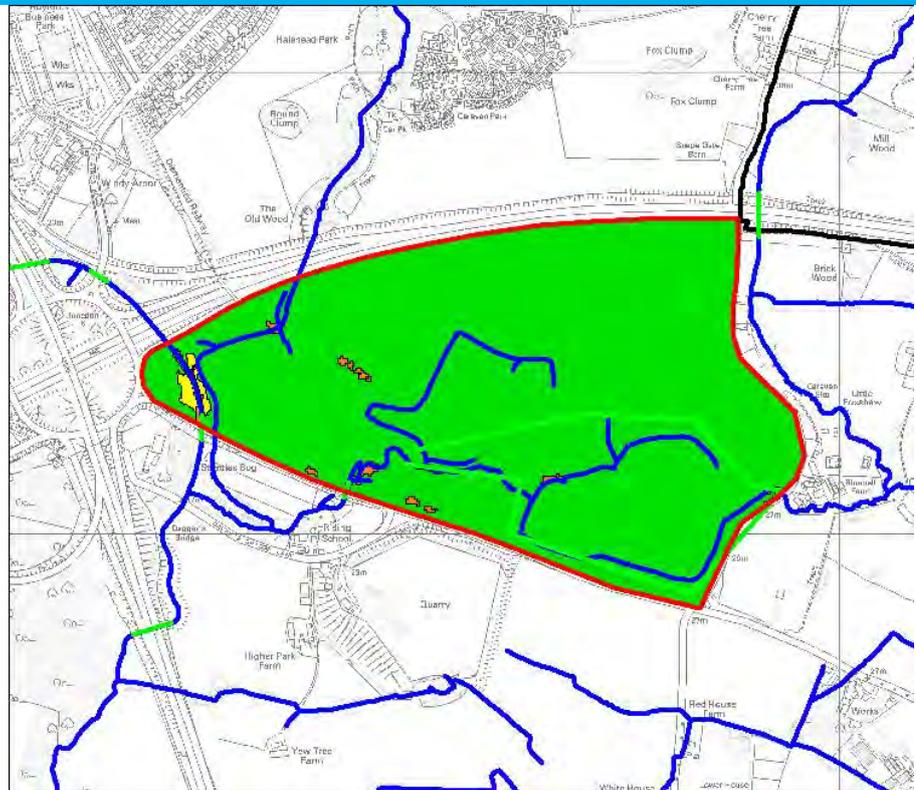
LDF19

Site Name

Cronton Colliery

Developable Areas

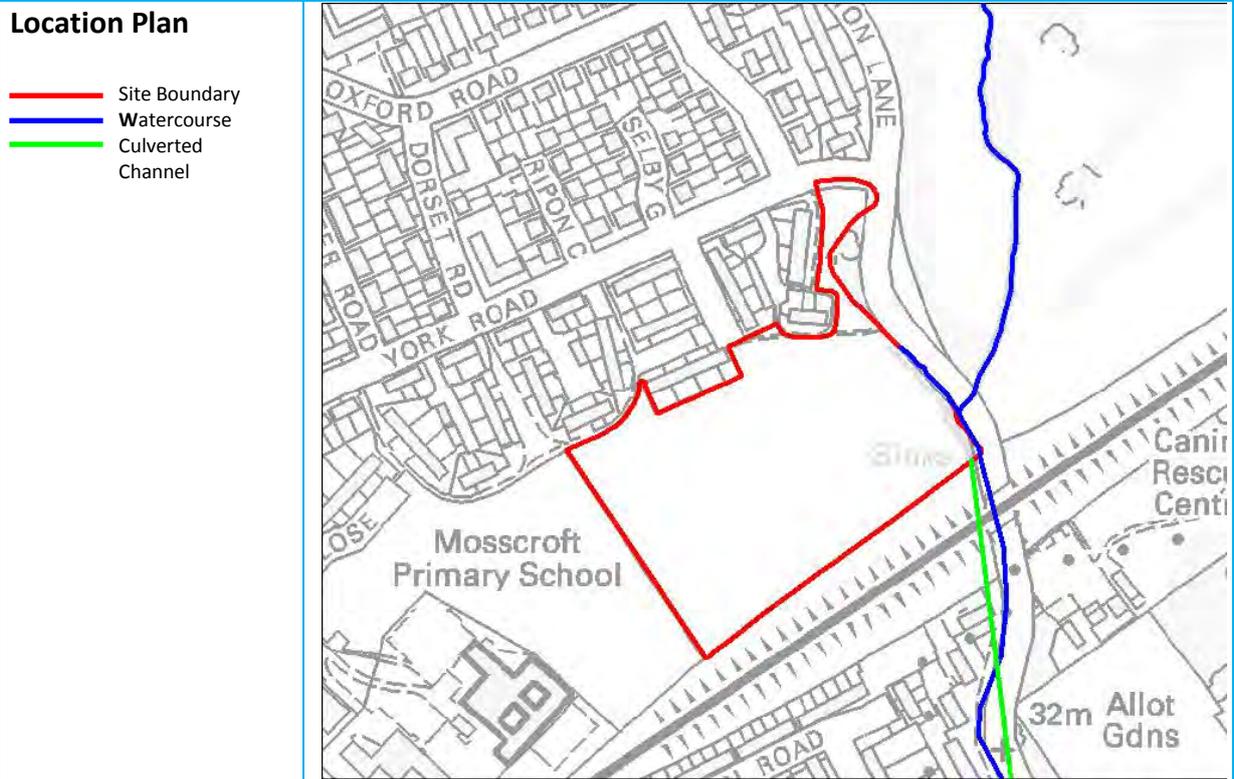
-  Site Boundary
-  Watercourse
-  Culverted Watercourse
-  Low Risk – All Types
-  Moderate Risk – More Vulnerable
-  High Risk – Less Vulnerable
-  V High Risk – Water Comp / Ess. Inf.



NB: Excludes Flood Zones associated with Fox's Bank Brook.



Site Number	K0375
Site Name	Open space at York Road, Huyton
Grid Reference	345625 391326



Size of Site (ha)	2.3ha
Type of development proposed / vulnerability classification	Residential / More Vulnerable Land Use
No. Of Dwellings Proposed	27
Rivers, watercourses and water bodies	Prescot Brook passes into the eastern corner of the site via a concrete lined channel that passes beneath Whiston Lane. A drain runs southwards along the eastern boundary to join with Logwood Mill Brook where it enters the site. Prescot Brook leaves the site via a 301m masonry culvert.
Description of Existing Flood Management Infrastructure (and condition)	NFCDD states that Prescot Brook is a regraded earth channel from upstream of Whiston Lane to the first footbridge on the golf course. The Standard of Protection (SoP) of the channel is 20% AEP (1 in 5 years). The condition is described as Poor (4) and the maintenance responsibility is the riparian owner. There is no information available on the drain, however, within the



Site Number	K0375
Site Name	Open space at York Road, Huyton
	<p>site the watercourse is of Fair condition (3), with an SoP of 20% AEP (1 in 5 years). The riparian owner is responsible for maintenance.</p> <p>The downstream culvert is again indicated to be privately maintained. As the structure passes beneath a railway line, various roads and multiple properties the maintenance responsibilities are likely to be complex. The structure is considered to be a major flood defence asset, it has a Fair (3) condition and an SoP of 20% AEP (1 in 5 years).</p>
Existing Land use	Open space.
Topography	The site slopes from west to east with ground levels varying from 36.3mAOD (along the western boundary) to 32.65mAOD (along the south-eastern boundary).
Risk Assessment	
Flood Zone Map	<p> — Site Boundary — Watercourse — Culverted Channel Flood Zone 3 Flood Zone 2 </p>
Proportion in FZ1	1.4ha (61%) in total.
Proportion in FZ2	0.9ha (39%) in total.
Proportion in FZ3a	0.8ha (35%) in total.
Proportion in FZ3b	0.03ha (1.3%) in total (from detailed modelling)
Actual Flood Risk	Hydraulic modelling of the Prescott Brook has refined the Environment Agency Flood Zones in this area.



Site Number

K0375

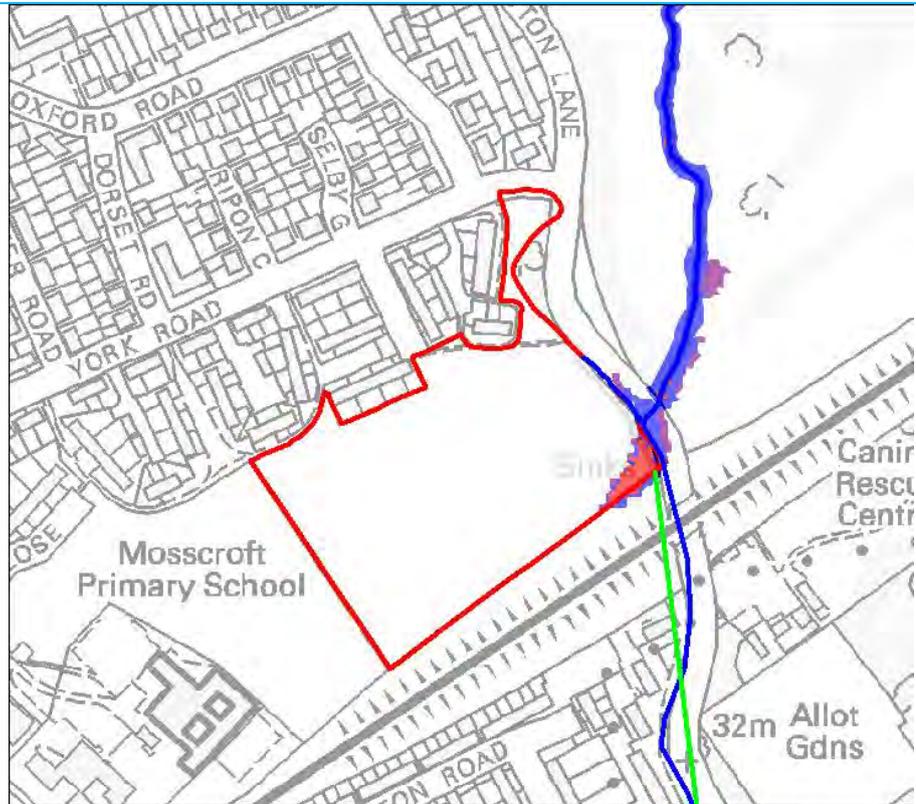
Site Name

Open space at York Road, Huyton

The 5% AEP (1 in 20 year effectively the Functional Floodplain) is shown to be predominantly aligned to the channel. There is some out of bank flooding shown within the south-eastern corner of the property. This could be attributed to the topography and restrictions of the downstream culvert on flows within the watercourse.

Actual Flood Risk Map

-  Site Boundary
-  Watercourse
-  Culverted Channel
-  5% AEP
-  1% AEP
-  1% AEP plus climate change



Site Number

K0375

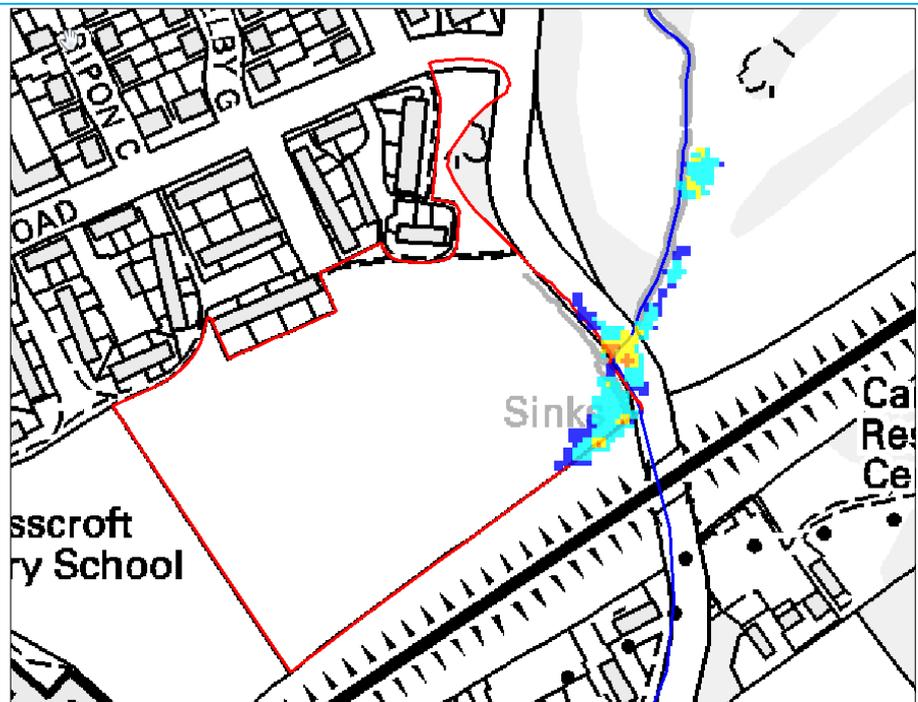
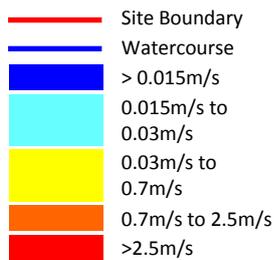
Site Name

Open space at York Road, Huyton

Depth 1% AEP event plus climate change



Velocity 1% AEP plus climate change





Site Number K0375

Site Name Open space at York Road, Huyton

Hazard 1% AEP plus climate change

-  Site Boundary
-  Watercourse
-  Low
-  Moderate
-  Significant
-  Extreme



Surface Water (Pluvial)

The site has a low to moderate risk of surface water flooding with some depths exceeding 0.3m being predicted within the topographic low areas of site during the 0.5%AEP event.





Site Number K0375

Site Name Open space at York Road, Huyton

Reservoir Flooding Map

-  Site Boundary
-  Watercourse
-  Culverted Channel
-  Reservoir Inundation



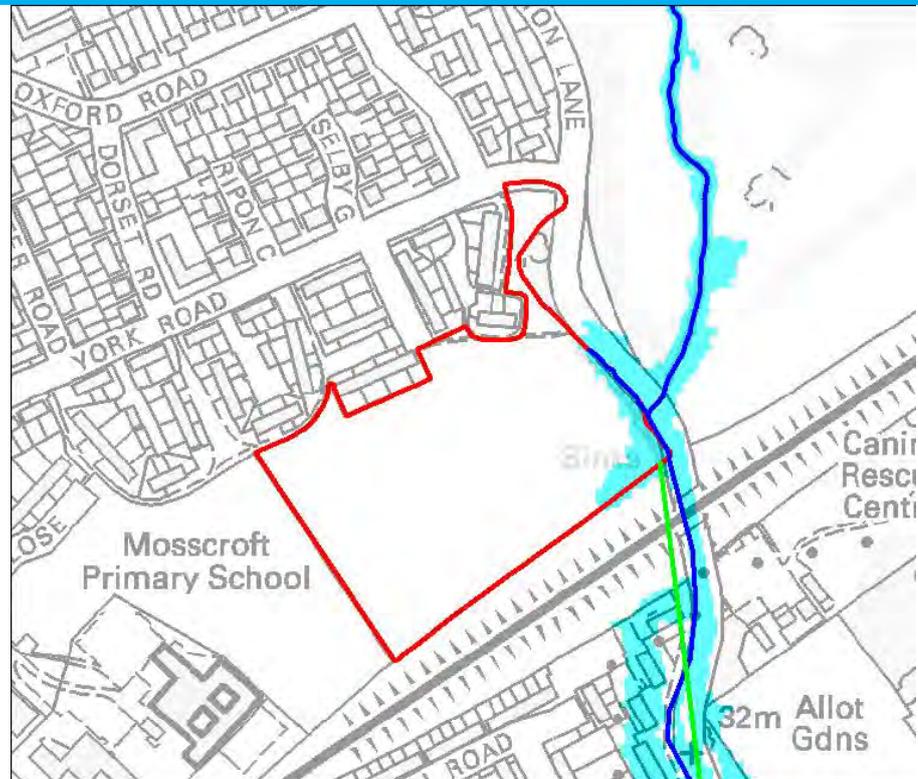
Residual Risk

Site Number K0375

Site Name Open space at York Road, Huyton

Residual Flood Risk Map

- Site Boundary
- Watercourse
- Culverted Channel
- 0.1% AEP



Summary of Risk

Just over half of the site is located within the Environment Agency's Flood Zone 1 and the remainder is shown to be within Flood Zone 2 or 3.

More detailed modelling shows that only a small area of the site is at risk during the 5% AEP fluvial event (the Functional Flood Plain) and this is predominately confined to the area upstream of the railway embankment/culvert and in lowest topographic area of the site. The extent of the 1% AEP, 1% AEP plus climate change and 0.1% AEP events are not significantly greater.

The presence of culverts upstream and downstream of the site indicate a residual risk associated with blockage and this should be incorporated into flood risk management measures.

There is a low risk of flooding from surface water across the majority of the site with the greatest depths being the in lowest elevations of the site. Although indicated depths suggest that it would not be considered a significant constraint and the consequences could be managed. Depths of flooding on site are predicted to be greater than or equal to 0.1m with some areas experiencing flooding in excess of 0.3m.

The area is shown to lie in an area shown to be susceptible to







Site Number K0375

Site Name Open space at York Road, Huyton

Developable Areas

-  Site Boundary
-  Watercourse
-  Culverted Watercourse
-  Low Risk - All Types
-  Moderate Risk – More Vulnerable
-  High Risk – Less Vulnerable
-  V High Risk – Water Comp / Ess. Inf.







Site Number	LDF1
Site Name	Land at Bank Lane, Kirkby
Topography	Ground levels are lowest in the north of the site along Bank Lane, where levels are approximately 25-26m AOD. Levels are higher in the south of site, increasing to 28m AOD.
Risk Assessment	There is no detailed modelling available of the Simonswood Brook, therefore the EA flood zones are the best information available to determine the flood risk at the site.
Flood Zone Map	<p> — KMBC Boundary — Site Boundary — Watercourse █ Flood Zone 3 █ Flood Zone 2 </p>
Proportion in FZ1	6ha
Proportion in FZ2	2.2ha
Proportion in FZ3a	1.8ha
Proportion in FZ3b	There is no detailed modelling to identify the extent of Flood Zone 3b
Actual Flood Risk	There is no detailed modelling to identify how the actual risk of flooding differs to the Environment Agency's Flood Zone 3, the impacts of climate change on Flood Zone 3 or to identify the extent of Flood Zone 3b.









Site Number

LDF1

Site Name

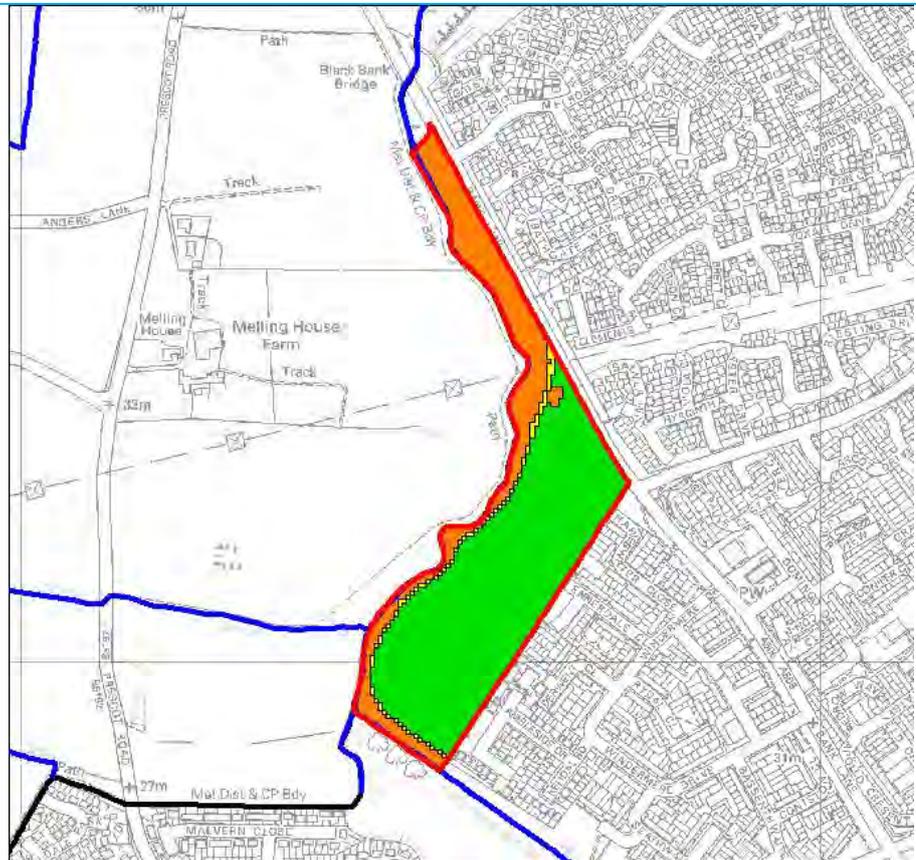
Land at Bank Lane, Kirkby

of managing flood risk, however, flood risk management options also include upstream storage on Simonswood Brook and ground raising or flood defences. This will increase flood risk low vulnerability land opposite but won't increase risk elsewhere. There may even be benefits to properties elsewhere.

The emerging Local Plan has identified that the site could accommodate 90 properties. Currently, however, without further mitigation, as described above, the developable land outside of High Risk areas is limited to 71% of the site.

Developable Areas

-  KMBC Boundary
-  Site Boundary
-  Watercourse
-  Low Risk - All Types
-  Moderate Risk – More Vulnerable
-  High Risk – Less Vulnerable
-  V High Risk – Water Comp / Ess. Inf.







Site Number A

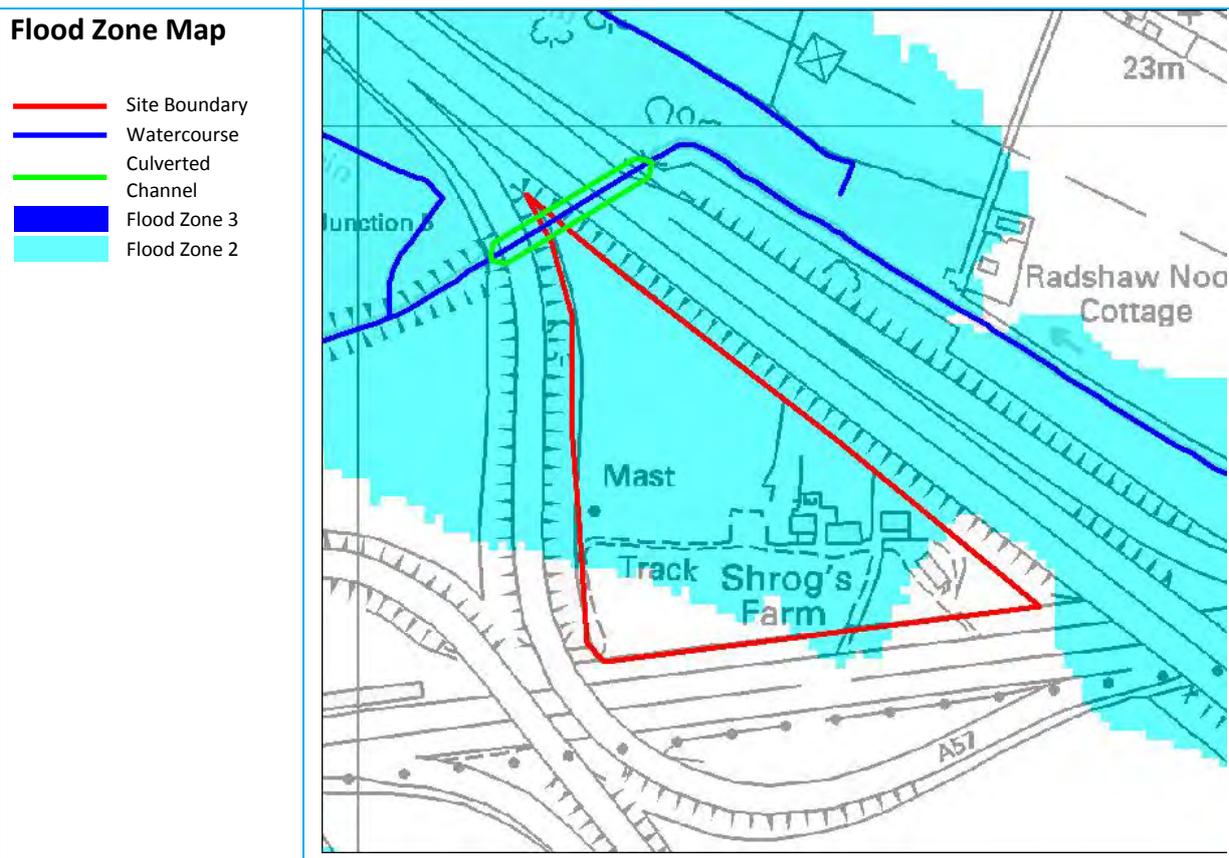
Site Name Shrog's Farm, East Lancashire Road, Kirkby.

The site does not benefit from raised defences along the Knowsley Brook that are designed to protect the site from flooding, however, the culverted Knowsley Brook combined with the raised sections of the M57 and slips roads results in protection to the site from fluvial flooding.

Existing Land use Greenfield.

Topography Ground levels are relatively flat across the site ranging from 17-19m AOD, the highest ground levels are observed along the eastern and southern boundary.

Risk Assessment There is no detailed modelling available of the Knowsley Brook, therefore the EA flood zones are the best information available to determine the flood risk at the site.



Proportion in FZ1 0.6ha

Proportion in FZ2 2.4ha

Proportion in FZ3a 0ha

Proportion in FZ3b There is no detailed modelling to identify the extent of Flood Zone 3b



Site Number	A
Site Name	Shrogs Farm, East Lancashire Road, Kirkby.
Actual Flood Risk	There is no detailed modelling to identify how the actual risk of flooding differs to the Environment Agency’s Flood Zone 3, the impacts of climate change on Flood Zone 3 or to identify the extent of Flood Zone 3b.
Surface Water (Pluvial) Map <ul style="list-style-type: none"> — Site Boundary — Watercourse — Culverted Channel FMfSW 200yr deep FMfSW 200yr 	
Groundwater	The site is not located in area identified to be susceptible to groundwater flooding. However, the site is shown to be located in a Groundwater Source Protection Zone 2, (SPZ). Consultation should be held with the Environment Agency to determine their policy position. SPZs are established to protect groundwater from pollution within a catchment of a public water supply borehole.
Artificial Sources	The site is not located in an area shown to be at risk from reservoir flooding.
Residual Risk	There is no detailed modelling to identify how the actual residual risk of flooding differs to the Environment Agency’s Flood Zone 2.
Summary of Risk	The site is predominantly located in Flood Zone 2 (80% of the site) with flooding associated with Knowsley Brook. There is no detailed modelled flood risk information available for Knowsley Brook and therefore it is not possible to identify the Actual Risk associated with







Site Number

A

Site Name

Shrogs Farm, East Lancashire Road, Kirkby.

Developable Areas

-  Site Boundary
-  Watercourse
-  Culverted Watercourse
-  Low Risk - All Types
-  Moderate Risk - More Vulnerable
-  High Risk - Less Vulnerable
-  V High Risk - Water Comp / Ess. Inf.





Site Number	CS9B
Site Name	Stockbridge Village
	boundary of the site.
Description of Existing Flood Management Infrastructure (and condition)	<p>The River Alt flows in culvert along the south-western boundary of Stockbridge Village. NFCDD states that the culvert is Local Authority maintained and that it has a design standard of 50 years with a condition assessed as 3 (fair).</p> <p>The River Alt is in culvert from west of Chalfont Way (NGR 342839 392956) and is in open channel in the greenfield north of Hare Croft (NGR 341871 393773).</p> <p>Croxteth Brook rises in the north west corner of the area and flows in a northerly direction to meet the Knowsley Brook. NFCDD states that it is Environment Agency maintained, has a design standard of 100 years and has a condition of 3 (fair). It is described as a Major flood defence asset. The Standard of Protection is likely to decrease over time as the effects of climate change are realised.</p>
Existing Land use	Predominantly residential with a number of open spaces.
Topography	Ground Levels adjacent to the River Alt are approximately 22m AOD. Ground Levels in the east are the highest around the playing field and recreation ground are 27-28m AOD. Ground levels in the centre of Stockbridge Village are 23m AOD.
Risk Assessment	<p>There is no detailed modelling available of the River Alt or its tributaries upstream of the confluence with Kirkby Brook, therefore the EA flood zones are the best information available to determine flood risk.</p> <p>Out of bank flooding is shown to occur upstream of Stockbridge Village at Seth Powell Way (NGR 343572 392338). The flood zones do not take account of structures therefore the River Alt culvert would not be represented. It is recommended that a hydraulic model is built to inform future development proposals.</p>





Site Number

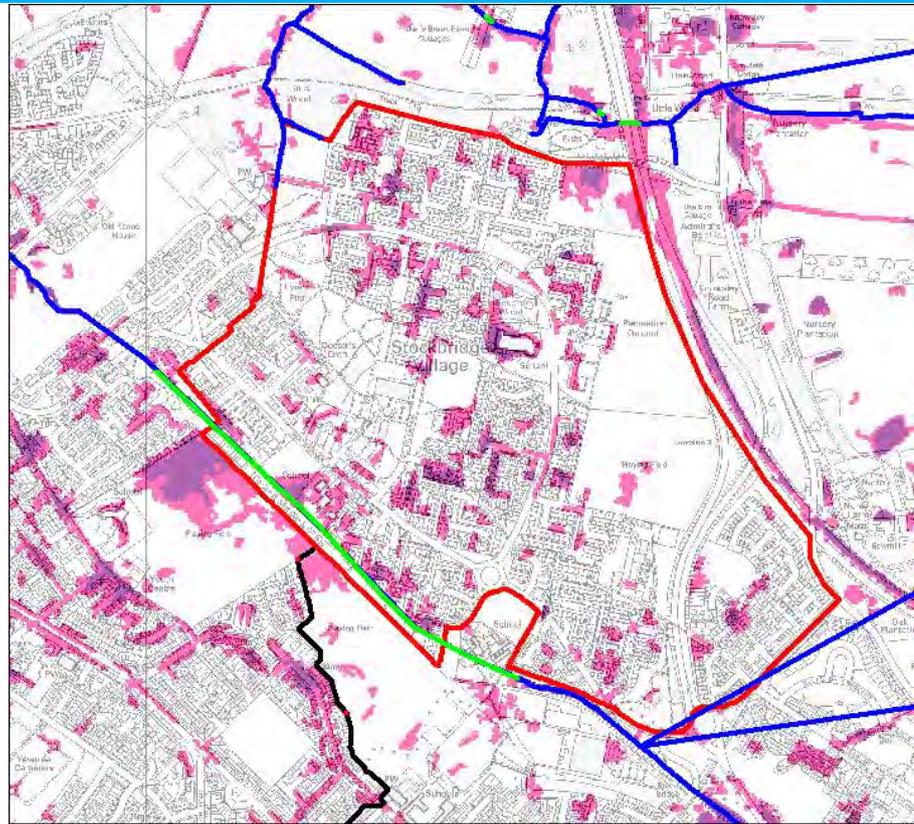
CS9B

Site Name

Stockbridge Village

Surface Water (Pluvial) Map

- KMBC Boundary
- Site Boundary
- Watercourse
- Culverted Channel
- FMfSW 200yr deep
- FMfSW 200yr



Groundwater

According to the EA groundwater susceptibility map, Stockbridge Village resides in a series of 1km squares where the proportion of each 1km square that is susceptible to groundwater flooding is less than 25%. The area to the north of Haswell Drive is shown to be located in a Groundwater Source Protection Zone 3, (SPZ). Consultation should be held with the Environment Agency to determine their policy position. SPZs are established to protect groundwater from pollution within a catchment of a public water supply borehole.

Artificial Sources

Significant areas of Stockbridge Village are shown to be potentially at risk of flooding from two reservoirs, Prescott No.4 and White Mans Dam. White Mans Dam is located within Knowsley Park approximately 1.8km east of the area and is maintained by the Earl of Derby's Estate (NGR 344965 394135). Prescott No.4 is located slightly outside of Knowsley (NGR 347090 394112) and is maintained by United Utilities Plc. The northern part of Stockbridge Village is shown to be at potential risk of reservoir flooding from both reservoirs, the south west boundary is shown to be at risk from Prescott No. 4 reservoir only.





















Site Number

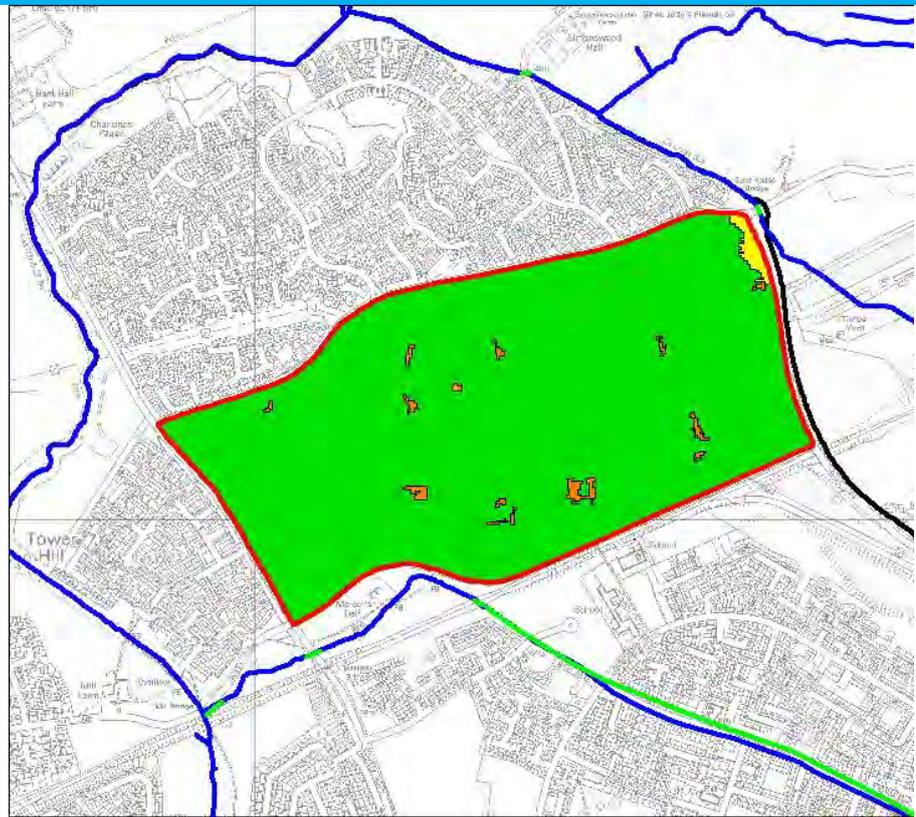
CS12

Site Name

Tower Hill, Kirkby

Developable Areas

-  KMBC Boundary
-  Site Boundary
-  Watercourse
-  Culverted Watercourse
-  Low Risk - All Types
-  Moderate Risk – More Vulnerable
-  High Risk – Less Vulnerable
-  V High Risk – Water Comp / Ess. Inf.





Site Number	B
Site Name	Epicentre, Land adjacent to M57
Grid Reference	342688 395882
Location Plan	
Size of Site (ha)	82ha
Type of development proposed / vulnerability classification	Sport/Leisure - less vulnerable
No. Of Dwellings Proposed	N/A
Rivers, watercourses and water bodies	The principal watercourse associated with the site is Croxteth Brook, which runs along the south western boundary. Small tributaries (drains) flow through the site to meet Croxteth Brook. One of these originates by ponds in Homer Wood and there are a number of others that lie to the south and south east of this. Another drain enters the site in the very southern corner to discharge into Croxteth Brook.
Description of Existing Flood Management Infrastructure (and	NFCDD states that Croxteth Brook is a maintained channel (Environment Agency) from the area close to Zander Grove to the track off Alder Lane. The Standard of Protection (SoP) of the channel is 1% AEP (1 in 100 years). The condition of the channel is



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Site Number	B
Site Name	Epicentre, Land adjacent to M57
condition)	<p>described as Fair (3).</p> <p>There is no condition, SoP or maintenance information on the drains within the site, though it is assumed maintenance responsibility will be the land owners.</p>
Existing Land use	<p>The site covers 82ha, predominantly greenfield land, and is located to the south of Knowsley Business Park. An unnamed drain bisects the site (flowing north to south - its source is Homer Wood in the north of the site) where it discharges into the Croxteth Brook. Two small area of existing brownfield land are located in the north-western and north-eastern corners of the site.</p>
Topography	<p>The site generally falls from northeast to southwest with the area being bisected from northwest to south east by the M57 which is higher than surrounding ground levels.</p> <p>Ground elevations in the northeast are between 32m AOD to 25mAOD.</p> <p>Ground elevations in the southwest are between 19mAOD to 22m AOD.</p> <p>The M57 is located at ground levels of 26.2mAOD (west) and 22.7mAOD (east).</p>
Risk Assessment	













Site Number

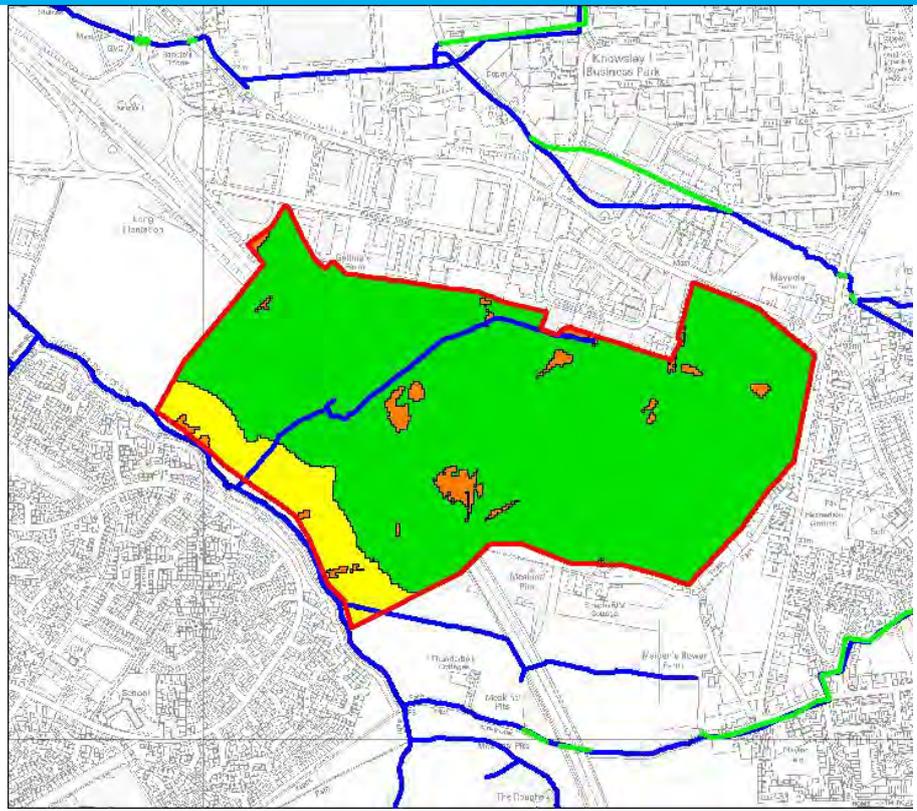
B

Site Name

Epicentre, Land adjacent to M57

Developable Areas

-  KMBC Boundary
-  Site Boundary
-  Watercourse
-  Culverted Watercourse
-  Low Risk - All Types
-  Moderate Risk – More Vulnerable
-  High Risk – Less Vulnerable
-  V High Risk – Water Comp / Ess. Inf.



















Site Number

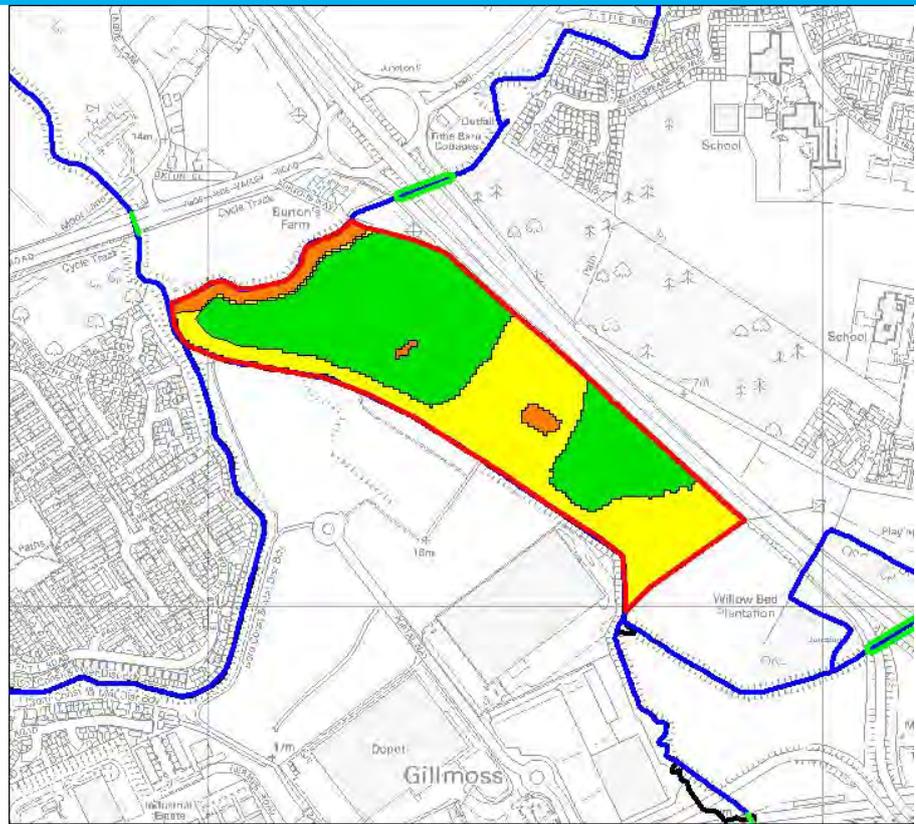
F

Site Name

Axis Business Park

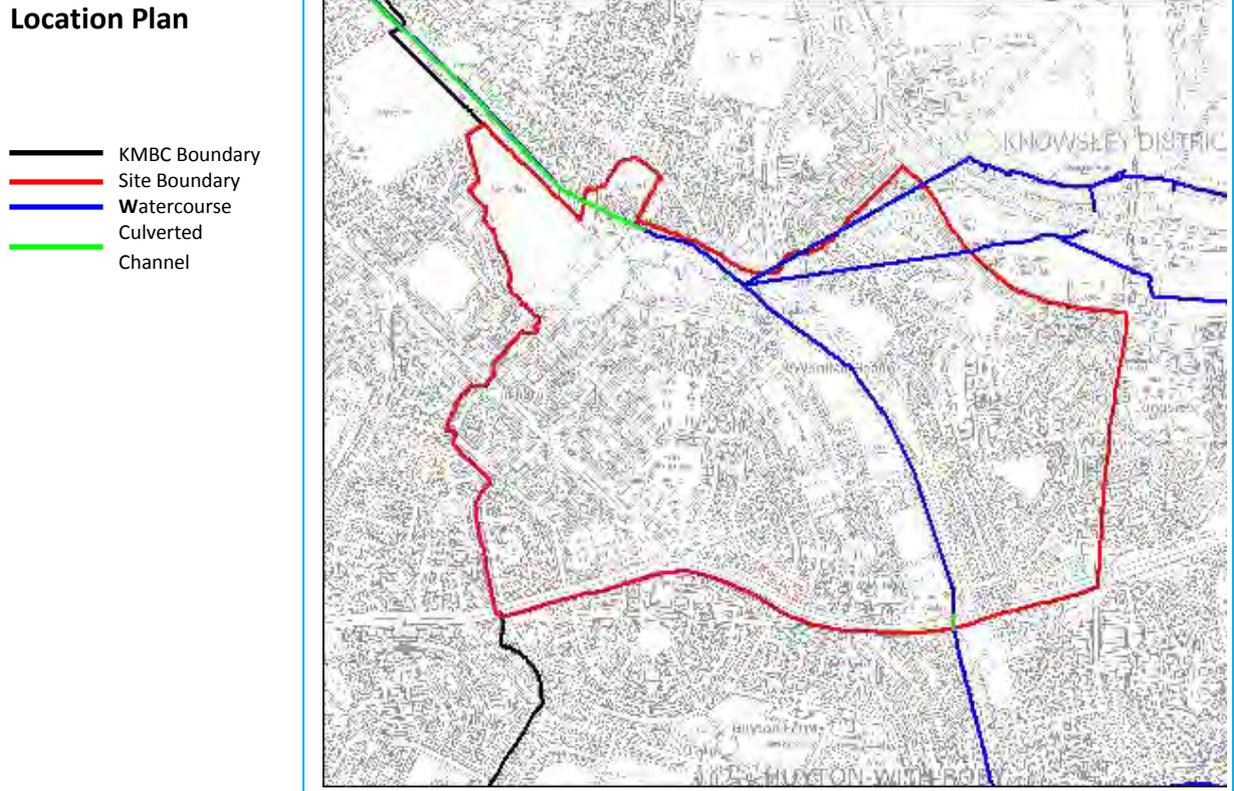
Developable Areas

-  KMBC Boundary
-  Site Boundary
-  Watercourse
-  Culverted Watercourse
-  Low Risk - All Types
-  Moderate Risk – More Vulnerable
-  High Risk – Less Vulnerable
-  V High Risk – Water Comp / Ess. Inf.





Site Number	CS9A
Site Name	North Huyton
Grid Reference	343235 392544



Size of Site (ha)	185ha
Type of development proposed / vulnerability classification	Within the proposed North Huyton and Stockbridge Village Principal Regeneration Area - Mainly Housing, increased transport provisions and enhanced open space.
No. Of Dwellings Proposed	Up to 2,000
Rivers, watercourses and water bodies	The River Alt bisects the area centrally from south to north. Once at the northern boundary the watercourse enters a culvert before leaving the area where it continues to run within 50m of the northern boundary in a north westerly direction. Two smaller unnamed drains discharge into the River Alt in the

















Site Number

CS9A

Site Name

North Huyton

Developable Areas

-  KMBC Boundary
-  Site Boundary
-  Watercourse
-  Culverted Watercourse
-  Low Risk - All Types
-  Moderate Risk – More Vulnerable
-  High Risk – Less Vulnerable
-  V High Risk – Water Comp / Ess. Inf.

