11. Drainage and Flood Risk

Introduction

11.1 This chapter assesses the effects of the proposed development on flood risk and drainage. In particular, it considers the potential effects of the proposed development on existing hydrology and flood risk of the proposed development on the local area.

11.2 Within this chapter "the Site" refers to land that falls within the application boundaries A and B as identified in the Site Location Plans (Chapter 5: The Proposed Development, **Figure 1.1** and **Figure 1.2**).

11.3 The chapter describes the methods used to assess the impacts, the baseline conditions currently existing at the site and surroundings, the potential direct and indirect impacts of the development arising from drainage and flood risk, the mitigation measures required to prevent, reduce, or offset the impacts and the residual impacts. It has been written by Lees Roxburgh and is supported by the following appendices:

- **Appendix 11.1** – Flood Risk Assessment 6337/R2 July 2021 – The Lanes, Penwortham

Planning Policy Context

National Planning Policy

National Planning Policy Framework (updated 2021)

11.4 The aim of planning policy on development and flood risk are to ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas at highest risk:

- Where new development is, exceptionally, necessary in such areas, policy aims to make it safe without increasing flood risk elsewhere and where possible, reducing flood risk overall; and
- Emphasises the need to adopt proactive mitigation to protect developments against climate change in the long term

Planning Practice Guidance

- Provides additional guidance to ensure the effective implementation of the planning policy set out in the NPPF on development in areas of flood risk; and

- Provides more details on the Sequential and Exception Tests and vulnerability classification of developments (i.e. More Vulnerable residential developments), producing Flood Risk Assessments, with the inclusion of climate change and managing residual flood risk.

Local Planning Policy

11.5 The Central Lancashire Core Strategy is the key document within the Development Plan for South Ribble, Chorley and Preston. The South Ribble Borough Council Local Plan forms part of the statutory Development Plan and focuses on The South Ribble Urban Area including Penwortham, Lostock Hall, Bamber Bridge, Walton-le-Dale and Higher Walton.

11.6 The Core Strategy sets out the strategic vision for Lancashire up to the year 2026. It identifies South Ribble as likely to attract investors and visitors, capitalising on its location with improved transport and sustainable neighbourhoods.

Site Specific Policies

11.7 The Central Lancashire Core Strategy Policy 1 concentrates on development in Preston and South Ribble urban area and includes a strategic location to the south of Penwortham and North of Farington.

11.8 The strategic location has been identified due to the requirements for housing and employment land with the protection of existing Green Infrastructure.

11.9 Policy C1 (Pickering's Farm) of the South Ribble Local Plan is allocated for development to comprise 1,350 dwellings and deliver necessary infrastructure. The remaining area within the strategic location will be safeguarded for future development. The proposed development will bring forward 1,100 residential units within the allocated site on land within the Applicants' control.

Other Relevant Policy, Standards and Guidance

11.10 A review of publicly available guidance documents via the South Ribble Borough Council website has failed to reveal any relevant supplementary planning document or planning guidance.

Assessment Methodology and Significance Criteria

Assessment Methodology

11.11 The methodology adopted in this assessment has been to identify the sensitive receptors and then focus on identifying impact types and risks which have the potential to have a beneficial or adverse impact.

11.12 The assessment of potential impacts and significant effects should be an iterative process where the results of the assessment process are input into the design of the scheme and the development of mitigation measures.

11.13 The assessment of flood risk has been undertaken in accordance with the NPPF addressing the following;

- The potential for the proposed development to be affected by flooding either from the development proposal or external sources;
- The potential for the proposed development to increase the flood risk elsewhere;
- That mitigation measures introduced to deal with any risks identified can be successfully managed; and
- That the site can be developed and occupied safely.

11.14 The NPPF includes a requirement for taking into account climate change in assessing flood risk.

11.15 Reference has also been made to the ROC Consulting Phase 1 Desk Top Study September 2018 andBrownfield Solutions Ltd Geo-Environmental Assessment Report October 2020 in respect of hydrology, geology and hydrogeology.

11.16 In the preparation of the FRA and this statement, Lancashire County Council Lead Local Flood Authority (LLFA) and United Utilities (UU) have been consulted.

11.17 Following the implementation of the preventative design measures, an impact assessment has been carried out to assess the likely residual impacts.

11.18 This section of the chapter presents the following

- Identification of the information sources that have been consulted throughout the preparation of this chapter;
- Details of the consultation undertaken with respect to hydrology, drainage and flood risk;
- The methodology behind the assessment of hydrological effects, including the criteria for the determination of sensitivity of a receptor and magnitude of change from the existing (baseline) condition;
- An explanation as to how the identification and assessment of potential hydrological effects has been reached; and
- The significance criteria and terminology for the assessment of the residual effects to flood risk, hydrology and drainage.

Data sources

11.19 Initial baseline information on the physical environment was gathered through the following sources:

- Environment Agency flood maps;
- Scheme proposals and design parameters;
- OS Mapping;

- Site specific LiDAR and Topographic Data;
- British Geological Survey geology mapping;
- Site Visits; and
- United Utilities sewer records.

11.20 This chapter of the ES has been accompanied by a site-specific Flood Risk Assessment Ref. 6337/R2 July 2021 (FRA) including a Flood Study Report by McCloy Consulting and is included in **Appendix 11.1**.

11.21 A Drainage Strategy has also been prepared for the site and incorporated in the FRA which identifies the proposed development discharging surface water runoff into a tributary of Mill Brook at two locations and foul drainage being pumped to the existing sewer network to the north.

Assessment of Climate Change

11.22 In accordance with the *Flood Risk Assessments: Climate Change Allowances* climate change allowances applicable to this site are predictions of anticipated change for peak river flow (by river basin district) and peak rainfall intensity.

Peak Rainfall

11.23 In the North West River Basin District, wetter winters and more rain falling in wet spells may increase river flooding for rivers and tributaries. More intense rainfall causes more surface runoff, increasing localised flooding and erosion. In turn, this may increase pressure on drains, sewers and water quality. Storm intensity in summer could increase even in drier summers. Rising sea or river levels may increase local flood risk inland or away from major rivers because of interactions with drains, sewers and smaller watercourses.

11.24 In accordance with the *Flood Risk Assessments: Climate Change Allowances*, for the surface water runoff assessment of a residential development (100 year lifetime), the flood risk assessment is required to assess both the central (20%) and upper end (40%) allowances to understand the range of impacts at the site.

11.25 As such an allowance of a 40% increase in the rainfall intensity values for the period 2060 to 2115 have been included to account for the impact of climate change on the design of the development.

Study Area

11.26 The FRA needs to assess the wider area beyond the redline boundary since third party land will continue to drain on a greenfield basis following the topography and these flows will need to be managed. Therefore, the full allocation area is considered as part of the FRA and hence the study area covered by this chapter addresses the full area allocated for residential development.

Consultation

Table 11.1 - Consultation

Consultee	Comments	Actions
Environment Agency	Not within their jurisdiction. Responsibility of Lancashire County Council	None required
Lancashire County Council Lead Local Flood Authority (LLFA)	FRA and drainage proposals to comply with the requirements of the NPPF	FRA and drainage proposals prepared accordingly.
United Utilities	Foul connection can be made to the existing network at agreed locations.	Drainage proposals prepared accordingly.

Potential Impacts Scoped into the assessment

Construction

11.27 The potential impacts on the water environment from the construction works are set out below:

11.28 The proposals during the construction of the site are for the erection of residential units on site following ground engineering works to form the attenuation basin and swale areas. These proposals will result in altered flow paths from the existing situation, with enabling works and construction plant potentially impeding overland flow.

11.29 Silt laden runoff from the site is created when heavy rainfall causes the mobilisation of fine sediments in surface water runoff. The effects of surface water runoff and sediment mobilisation are exacerbated with the removal of vegetation for construction purposes leaving areas of bare top / subsoils and the storage of excavated materials in stockpiles within the site boundary.

11.30 The ingress of sediments into a watercourse can have an effect flood risk, with increased siltation affecting hydrology and reducing channel depth and in turn reducing the capacity of the channel.

11.31 Construction works have the potential to result in debris entering the watercourse. Should debris enter the watercourse, this could lead to either a reduction in channel capacity or a blockage of existing structures.

11.32 Silt laden runoff from the site is created when heavy rainfall causes the mobilisation of fine sediments in surface water runoff. The effects of surface water runoff and sediment mobilisation are exacerbated with the removal of vegetation for construction purposes leaving areas of bare top / subsoils and the storage of excavated materials in stockpiles within the site boundary.

11.33 The ingress of sediments into a watercourse can have a number of effects on water quality and aquatic life (reduction of oxygen levels and decreased sunlight penetration) and on the nature of the watercourse (increased siltation affecting hydrology and reducing channel depth).

11.34 Where fuels, oils and other chemicals enter a watercourse, they can have a number of effects on water quality and can be particularly harmful to the local aquatic environment.

11.35 Concretes and cements, when entering a watercourse, can have a number of effects on water quality. Concretes and cements are highly alkaline and corrosive and can cause serious pollution to watercourse. Invertebrates and fish are particularly sensitive to changes in pH levels. Unlike oil spillages, changes to pH levels in watercourses are not immediately apparent and can occur for some time before the extent is realised.

11.36 Concretes and cement dust and debris could potentially reach surface water receptors following accidental spillages during construction, via overland flow, wastewater or via dispersal of concrete dust.

11.37 Inappropriate disposal of foul waste during the construction could potentially reach surface water receptors via overland flow. With potentially similar effects the spillages of chemicals, such instances could have a number of effects on water quality and be harmful to local aquatic life.

11.38 The capacity of the culverts beneath Penwortham Way presents a potential issue with regards to the backing up of the watercourses, leading to an increased flood risk to the east. Onsite construction works could present a risk of the blocking of the culverts.

11.39 The infilling of some existing ditches on site is anticipated. Such works could result in changes to flow regimes in the area and alter flood risk downstream either on site or off site.

Completed Development

11.40 During the operational phase, there is the potential for the Proposed Development to result in the following impacts on the water environment:

- Surface water drainage strategy (impermeable areas altering surface water runoff rates and increasing flood risk);
- Changes to flood risk to the new population (including climate change);
- Changes to flood risk caused by the development to the existing population both locally within the site and to the north and north west (including climate change); and
- Water Quality and Pollutant spillages/transport from vehicular and household activities.

11.41 The Proposed Development will result in changes in the onsite drainage networks / regimes. The outline proposals for the onsite drainage network are provided in the Flood Risk Assessment, but in summary, the proposals are for:

- Discharge of post development surface water runoff to be significantly reduced as compared with predevelopment runoff; and
- Creation of a flood basin along the northern boundary to better manage existing surface water runoff entering the site from the north.

Significance Criteria

11.42 The assessment includes a qualitative assessment of potential effects on flood risk, hydrology and drainage from construction works and operational activities on site.

11.43 Potential effects of the Proposed Development on flood risk, hydrology and drainage have been identified and assessed using criteria from the Institute of Environmental Management and Assessment (IEMA, 2011).

11.44 The content of this assessment has been identified through a combination of project experience, available documentation, consultation and professional judgement.

11.45 The assessment of effects has taken into account the sensitivity/importance of the receptor and the magnitude of the effect on that receptor as set out below:

Table 11.2: Sensitivity Criteria and Hydrology Receptors

Sensitivity	Criteria Guide	Receptors
High	The receptor has low ability to absorb change without fundamentally altering its present character, is of high environmental value, or of national importance.	None
Medium	The receptor has moderate capacity to absorb change without significantly altering its present character, has some environmental value, or is of regional importance.	Mill Brook Secondary Aquifer-A
Low	The receptor is tolerant of change without detriment to its character, is of low environmental value, or local importance	Mill Brook tributary On site ditches

11.46 The magnitude of the potential effects resulting from the environmental impacts of the development (adverse or beneficial) on flood risk, hydrology and drainage is outlined in Table 11.3. The allocation of the level of magnitude is identified through the consideration, and application of professional judgement and the assessment of the supporting evidence.

Table 11.3: Magnitude Criteria

Magnitude	Criteria Guide
High	Total loss or major alteration to key elements or features of the baseline conditions to the extent that post-development character or composition of baseline conditions will be fundamentally changed. (E.g. large increase or decrease in peak flood level, significant deterioration or improvement of water quality)
Moderate	Loss or alteration to one or more key elements or features of the baseline conditions to the extent that post-development character or composition of the baseline conditions will be materially changed. (E.g. moderate increase or decrease in peak flood level, moderate deterioration or improvement of water quality)
Low	Minor shift away from baseline conditions. Changes arising will be detectable but not material; the underlying character or composition of the baseline conditions will be similar to the pre-development situation. (E.g. slight increase or decrease in peak flood level, slight deterioration or improvement of water quality)
Negligible	Very little change from baseline conditions. Change is barely distinguishable, approximating to a 'no change' situation. (E.g. no discernible effects on hydrological elements (neither beneficial nor adverse)

11.47 The effect is the term used to express the consequence of an impact (expressed as the significance of effect), which is determined by correlating the magnitude of the effect to the sensitivity of the receptor. This is achieved using the matrix presented in Table 11.4.

Table 11.4: Indicative guide to relationship between sensitivity and magnitude of change

Magnitude	Sensitivity		
	High	Medium	Low
High	Major beneficial or adverse effect	Major or Moderate beneficial or adverse effect	Moderate or Minor beneficial or adverse effect
Moderate	Major or Moderate beneficial or adverse effect	Moderate beneficial or adverse effect	Minor beneficial or adverse effect

Magnitude	Sensitivity		
	High	Medium	Low
Low	Moderate or Minor beneficial or adverse effect	Minor beneficial or adverse effect	Minor beneficial or adverse effect or negligible effect
Negligible	Negligible effect	Negligible effect	Negligible effect

11.48 The terms as used within the table have been defined below:

- **Major Adverse / Beneficial effect**: where the development will cause significant improvement (or deterioration) to the existing environment;
- **Moderate Adverse / Beneficial effec**t: where the development will cause noticeable improvement (or deterioration) to the existing environment;
- **Minor Adverse / Beneficial effect**: where the development will cause perceptible improvement (or deterioration) to the existing environment; and
- **Negligible**: no discernible improvement or deterioration to the existing environment.

Assumptions/Limitations

11.49 Reliance has been placed on factual and anecdotal data obtained from the sources identified above. New information, revised practices or changes in legislation during the assessment or development stages may necessitate the reinterpretation of the report, in whole or in part.

11.50 There are no significant areas of uncertainty with regard to the assessment of hydrological and environmental effects and mitigation measures. However, further hydrological assessment may be undertaken at the detailed design stage during reserved matters applications for development purposes.

11.51 Overall, despite the potential uncertainties, it is considered that the available data is sufficient to provide a robust basis for the assessment undertaken.

Baseline Conditions

11.52 This section describes the baseline conditions at the site (and surrounding area as appropriate). A detailed Flood Risk Assessment and hydraulic modelling exercise have been undertaken for the application and are included as **Appendix 11.1**.

Hydrology

Existing Drainage

11.53 The River Lostock meanders north to south east beyond the railway line and Leyland Road.

11.54 The site itself lies within the catchment of the River Ribble to which Mill Brook outfalls some 4.5km to the north west of the site.

11.55 Mill Brook crosses Chain House Lane to the south, dog legs within the Safeguarded Land before turning west forming a short section of the southern application boundary and then crosses Penwortham Way in 900mm diameter culvert.

11.56 A tributary culvert runs just beyond the northern boundary of the site and flows west into the Kingsfold estate, turns south west into open channel and then crosses beneath Penwortham Way in 750mm diameter culvert to join Mill Brook.

11.57 There are numerous shallow minor ditch systems, particularly within the southern area of the site, flows from which are ultimately either picked up by the northern culvert or more directly by Mill Brook via minor piped culvert crossings.

11.58 At the north west boundary there is a manhole at the foot of the A582 embankment with a 300mm piped outfall that passes through manholes within Penwortham Way before outfalling into Mill Brook to the west.

11.59 There is a second outfall across Penwortham Way some 200m north of the Mill Brook culvert crossing.

11.60 The presence of these systems is consistent with the nature of the underlying clay ground conditions.

11.61 Foul drainage from existing development is not connected to the adopted sewer network and is dealt with at source.

Water Quality

11.62 Mill Brook is not a recorded watercourse under the Water Framework Directive.

Flood Risk

11.63 The flood risk to the site is assessed in detail in the Flood Risk Assessment (**Appendix 11.1**). The following is a summary of the findings from the report.

Fluvial

11.64 Reference to Flood Mapping indicates that the site is situated within a Flood Zone 1 Area of flood risk some distance from the nearest area of flood risk Zone 2/Zone 3 associated with the River Lostock to the north east.

11.65 Zone1 is land defined within the NPPF as assessed as having a less than 1 in 1000 annual probability of flooding (<0.1% in any year). All uses of land are appropriate in this zone.

Pluvial

11.66 Reference to Flood Risk Mapping identifies sporadic areas of risk surrounding the site and within the site becoming more concentrated to the west alongside Penwortham Way and, more significantly, extending centrally north towards and beyond the Kingsfold boundary.

Groundwater

11.67 Reference to BGS mapping identifies a general risk of groundwater flooding across the site.

Reservoir

11.68 Reference to reservoir flood maps identifies the site is not at risk from reservoir flooding.

Sewers and Drains

11.69 Reference to United Utilities public sewer records identifies adopted drainage infrastructure in the area of the site comprising:

- Extensive system of foul and surface water drainage within the adjacent residential development; and
- Surface water culvert system at the north boundary of the site forming the tributary to Mill Brook and not a United Utilities asset

11.70 There are no public sewers recorded within the site.

11.71 Penwortham Way is served by a highway drainage system which is connected to Mill Brook via the various road culverts.

Geology / Hydrogeology

11.72 The ground conditions and geology of the site are detailed in the Ground Conditions Chapter (Chapter 10). A brief summary of the ground conditions encountered beneath the site follows.

11.73 The site is not shown to be located within an Environment Agency Source Protection Zone.

11.74 The site is shown to be predominantly underlain by glacial clays classified as a Secondary Aquifer Undifferentiated in turn underlain by mudstone classified as a Secondary Aquifer A.

Ecological Designations

11.75 There are no nationally or internationally designated sites located within 250m of the area proposed for the development.

11.76 The impact of the development on the above designations has been assessed in detail in Chapter 7: Ecology and Nature Conservation.

Embedded Mitigation

11.77 This section describes the measures which have been 'embedded' into the development focusing on drainage and flood risk. Embedded mitigation measures are presented within Chapter 5, 'The Proposed Development' and the relevant technical chapters of this ES.

11.78 The following aspects of the design are considered embedded mitigation and fundamental to the delivery of the development in terms of hydrology and flood risk. The embedded mitigation measures will be designed into the construction phase and provide benefits during both the construction and operational phases.

11.79 The embedded mitigation measures comprise the following:

- Standoffs to Mill Brook northern tributary culvert; and
- Improved maintenance and efficiency of the minor ditch systems and land drainage generally within the confines of the site boundary.

11.80 As noted in this Chapter and accompanying Flood Risk Assessment, the area of the site outlined for development is shown to lie in Flood Zone 1.

11.81 The standoff to the culvert required will be agreed with the LLFA. Minor drainage ditches will require on-going maintenance and should be provided with the appropriate standoff for access dependent upon the level of maintenance required.

Surface Water Drainage Design

11.82 The drainage strategy has been agreed with the LLFA and UU. The surface water drainage for the site will be embedded for the operational phase of the development. The proposed SuDS for the site comprise an extensive basin and swale system as shown on the drainage strategy prepared for the site.

11.83 The dimensions, volumes and extent of the SuDS features will need to be adjusted as the masterplan develops and during the detailed planning stage. Detailed design of individual features is not part of the scope of this report. A summary of the strategy follows.

11.84 Two main surface water outfalls from the development area are proposed to the northern tributary boundary culvert and the second, direct to this system where it crosses Penwortham Way to the north west, downstream of Kingsfold.

11.85 The area most vulnerable to surface water flooding lies to the northern area of the site and relies for drainage on the northern tributary culvert which flows through the adjacent Kingsfold development.

11.86 A ditch and a flood basin area will be formed along the north boundary to pick up, contain and overall, better manage surface water flows entering from the north.

11.87 Development levels will be set above the design risk level.

11.88 On this basis, a reallocation of contributing area from the existing northern catchment into developed southern catchment is proposed with a commensurate reduction in run off rates and volumes, and hence flood risk to existing and proposed development in the northern area.

11.89 Additionally, development run off rates overall will be significantly reduced from existing rates.

11.90 The proposals therefore will achieve a significant reduction in the rate of surface water run-off into the Mill Brook tributary.

11.91 Surface water flows from the southern catchment will be attenuated onsite within an attenuation basin and swale system located alongside the central estate road and the west boundary with Penwortham Way.

11.92 Surface water flows from the developed northern catchment will be contained in pipe and pumped into the northern culvert system which will continue to receive flows from retained land.

11.93 Highways, houses and associated hard surfaces will be served by piped surface water systems designed to adoptable standards to ensure, at minimum, no flooding up to the 1 in 30year event.

11.94 Overall flows up to the 1 in 100-year event plus allowance for climate change (40%) within both systems will be contained on site within the basin, swale and pipe systems, supplemented by appropriate setting of levels.

11.95 The existing lanes and property will continue to be drained by the land drainage.

11.96 Overall development levels will be set to create overland flow paths to ensure that there is no increased risk of surface water flooding to existing property and, where achievable, any existing risk is mitigated.

11.97 Ground conditions preclude infiltration, limiting opportunities to address water quality. However, the risks associated with residential housing range from low to very low.

11.98 It is proposed that the pipe drainage from the central catchment be drained to an attenuation basin/swale system. This proposal together with trapped gullies to the adoptable roads will inherently provide two levels of treatment to address any perceived risk to water quality.

11.99 For the northern catchment, given the requirement to pump surface water, one level of treatment will be provided by the introduction of trapped gullies to adoptable roads.

Foul Drainage Design

11.100 It is proposed that foul drainage arrangements will substantially mimic the surface water drainage proposals.

11.101 A gravity foul drainage system will follow the topography down the central estate road to a pumping station located alongside the approach to Penwortham Way.

11.102 From here flows will be pumped north west along Penwortham Way and will be connected into the UU combined sewer system in Pope Lane.

11.103 Within the northern catchment a gravity network will be run down to a location close to the north boundary and will be pumped across the open space area and connected to the UU combined sewer system in Kingsfold Drive.

11.104 These proposals have been agreed by UU.

Assessment of Likely Significant Effects

11.105 With reference to the Indicative Phasing Plan (**Figure 5.9**), it is not considered that any significant impact would result from a phased approach as potential impacts during construction will be mitigated through measures within the Construction Environmental Management Plan (CEMP) and potential impacts within completed phases will be mitigated through the drainage strategy. Similarly, should Proposed Development Phasing Strategy be amended at a later date, it is considered unlikely any additional impacts (over and above those noted within the current assessment) may arise, however, a condition will be imposed which ensures that any change in the phasing which could change the assessment of impacts would be accompanied by an environmental statement dealing with such changes. Similarly, if Application B is not brought forward it will not give rise to significantly different impacts than Application A only as the area will continue to drain as it does currently.

Climate Change

11.106 Flow increases of 40% have been factored into the flood modelling exercise and accommodated for in the flood storage area. Climate Change allowances in terms of increased rainfall are included as part of the outline drainage strategy for the proposed development.

Demolition and Construction

11.107 This section of the Chapter considers the effects during the construction phase with embedded mitigation in place.

11.108 This section assesses the potential effects of the proposed development on the sensitive receptors as outlined in Table 11.2.

Fluvial Flood Risk

11.109 As noted, the impacts of the development on flood risk have been considered with the embedded mitigation in place. The site is located within Environment Agency Flood Zone 1.

11.110 The impact on risk of flooding to areas to existing adjacent property following the formation of the flood basin works is considered **moderate beneficial** by providing a designated area to contain surface water run off.

11.111 Following the groundworks comprising the formation of the SUDS features the significance of effect to the site flood risk is considered **major beneficial** by providing designated areas to contain surface water run off.

11.112 During the construction phase, the numerous minor ditches within the site will either remain and be improved or be diverted. The infilling of the ditches will present a long-term impact and permanent, though highly restricted to the site.

11.113 In terms of flood risk, the on site ditches would be categorised as low sensitivity features, being relatively insignificant in nature but do contribute to current flood storage in the area as part of the general land drainage. The inclusion of the SUDS features mitigates against this risk providing a low magnitude of impact. As a result, the impact of the ditch proposals in terms of reducing flood risk to existing and proposed property is considered **moderate beneficial**.

Fluvial Flood Risk and Sedimentation of Watercourse

11.114 During the construction period, the groundworks in particular will result in areas of soil being exposed or stockpiled. During a rainfall event, sediment and other particles could be washed into the onsite watercourses. The washing of soils and sediments towards the Mill Brook tributaries is considered a short-term impact that could result in a temporary, adverse effect on the flood risk in the watercourses.

11.115 In terms of flood risk, Mill Brook is considered a low sensitivity watercourse. As a result of the potential for sediment ingress into the watercourses, the predominantly low flow nature and the current culvert inefficiency beneath the bypass, the potential for the sediment to settle is increased. This in turn could lead to a reduction in the capacity of the various culverts and an increase in the risk of flooding from these sources.

11.116 Due to the nature of the embedded mitigation proposed in the form of SUDS the magnitude of change would be considered moderate beneficial. As a result, the impact with regards to fluvial flood risk and sedimentation of watercourse is **minor beneficial**.

Fluvial Flood Risk and Watercourse Blockage

11.117 During the construction period, debris from the site could be transported to the watercourse and potentially block the culverts.

11.118 In terms of flood risk, Mill Brook is considered a low sensitivity watercourse. As a result of the potential for debris and sediment ingress into the watercourses, the predominantly low flow nature and the current culvert efficiency beneath the bypass, the potential for the debris and sediment to settle and create a blockage is increased. This in turn would lead to a reduction in the capacity of the culverts draining the site increasing the risk of flooding.

11.119 Due to the nature of the embedded mitigation proposed in the form of SUDS, a reduction in flood risk will be achieved as a greater volume of flood water would be retained on site negating the impact of a blockage in the watercourse. As a result, the magnitude of the impact would be considered moderate beneficial. As a result, the impact with regards to fluvial flood risk and watercourse blockage is **minor beneficial**.

Water Quality – Sediment Mobilisation

11.120 Construction works in particular result in areas of soil being exposed. During a rainfall event, sediment and other pollutants could be washed into the onsite watercourses. The washing of soils and sediments into the onsite watercourses is considered a short term impact that could result in a temporary, adverse effect on the water quality in the watercourses. As noted above, the watercourses in the area are predominantly low flowing in their nature and may allow any washed off sediment to settle in the watercourses reducing quality and capacity.

11.121 In terms of water quality Mill Brook is considered to be low sensitivity receptors in terms of lack of designation under the Water Framework Directive. To facilitate the embedded mitigation groundworks, significant areas of stripped ground and stockpiled soils may be present on site, therefore increasing the potential for sediment mobilisation. The magnitude of the impact would be considered low for Mill Brook.

11.122 The effect of sediment mobilisation and settlement in Mill Brook in terms of water quality degradation would be considered **negligible**.

Water Quality – Fuel / Chemical Spillages

11.123 During the construction phase, hazardous chemicals and liquids will be stored on site and utilised throughout the construction process. The impact is considered, for both fuel and chemical spillages, short term in nature, with the potential for spillages present where the works are within close proximity to the culverts. The low flow characteristics of the drainage systems would make the instances containable in the close proximity to the site, reducing any downstream impacts.

11.124 In terms of water quality Mill Brook is considered to be a low sensitive receptor in terms of lack of designation under the Water Framework Directive. The magnitude of the impact would be considered negligible for Mill Brook.

11.125 The effect of spillages of hazardous chemicals and liquids on the Mill Brook system in terms of reduction in water quality as recorded under the Water Framework Directive would be considered a **moderate adverse** effect.

Water Quality – Cements and Concretes / Dust Ingress

11.126 During the construction phase, concrete and cements will be stored and utilised on site throughout the construction process. The impact is considered, for both concrete spillages and cement dust ingress, short term in nature, with the potential for spillages present where the works are within close proximity of the culverts systems. As noted above, the Mill Brook system is a low flow watercourse. The low flow characteristics of Mill Brook would make the instances containable in the close proximity to the site, reducing any downstream impacts.

11.127 In terms of water quality Mill Brook is considered to be a low sensitive receptor in terms of lack of designation under the Water Framework Directive. The magnitude of the impact would be considered negligible for Mill Brook.

11.128 The effect of spillages of concretes and cement dust ingress in Mill Brook in terms of reduction in water quality as recorded under the Water Framework Directive would be considered **negligible** for Mill Brook.

Water Quality – Foul

11.129 During the construction period, there is the potential for inappropriate/unconsented discharge of foul waste to the nearby watercourses. The impact is considered short term in nature and could result in a temporary, adverse effect on the water quality in the watercourses, though highly localised. As noted above, Mill Brook is considered to be a low sensitive receptor in terms of lack of designation under the Water Framework Directive. The magnitude of the impact would be considered minor adverse for Mill Brook.

11.130 The effect of inappropriate discharge of foul waste into the Mill Brook system in terms of reduction in water quality as recorded under the Water Framework Directive would be considered **minor adverse** for Mill Brook.

Completed Development

11.131 This section assesses the potential effects of the proposed development during the operational phase for each of the identified sensitive receptors. It is assumed that the operational lifetime of the development to be 100 years in terms of the residential aspect of the scheme.

11.132 During the operational phase, there is the potential for the utilisation of the Proposed Development to result in the following impacts on the water environment:

- Surface water drainage strategy (impermeable areas altering surface water runoff rates and increasing flood risk);
- Changes to flood risk to the new population (including climatic changes);
- Changes to flood risk of caused by the development to the existing population to the south (including climatic changes); and
- Water Quality and Pollutant spillages / transport from vehicular and household activities.

11.133 As a result of the Proposed Development, changes in the onsite drainage networks/regimes is expected. The outline proposals for the onsite drainage network are provided in the Flood Risk Assessment, but in summary, the proposals overall are for the discharge of post development surface water to be significantly reduced from pre-development runoff rates.

11.134 The increase in vehicle parking increases the potential for leaks and spillages of fuels, oils and other chemicals such as hydraulic fluids and antifreeze. Similarly, increases in vehicular movements could result in an increased mobilisation of diffuse highway pollutants and dusts. Periods of rainfall or direct discharge to the surface water network could result in the pollutants entering Mill Brook.

Surface Water Drainage Strategy

11.135 There are a number of typical operational activities that could pose a hazard to the water quality of the adjacent watercourses. With the completed proposals in place and the establishment of the surface and foul water drainage networks for the development and the fact that these features are located within area of greenspace, the impacts and consequential effects will be limited to **negligible**.

11.136 The key principle of the proposed surface water drainage for the Proposed Development is to discharge surface water to the watercourse network, via the use of onsite SuDS measures as detailed in the surface water drainage strategy. Under pre development conditions, precipitation falling within the site would usually flow over the ground towards the network of field drains and onwards to the Mill Brook tributary and minor culverts. As a result of the nature of the Proposed Development, there will be an increase in impermeable areas on site in the operational phase. The onsite drainage network will be designed in accordance with the details provided within the Flood Risk Assessment and include an allowance for climate change.

11.137 In summary, surface water drainage from the site will be significantly reduced from existing pre-development runoff rates. Further, the volume of run off to the northern boundary culvert will be reduced and diverted to outfall to the same system but downstream of the existing development. The discharge of surface water via the onsite drainage network will have a **major beneficial** effect on the Mill Brook system.

Foul Drainage Strategy

11.138 It is not envisaged that there will be any impacts on existing arrangements.

Changes to flood risk for the New Local Population and Existing Population (including climate change)

11.139 A drainage strategy has been developed for the proposed development so that surface and foul water will be conveyed from the site in an appropriate manner. As noted, the proposals for the onsite drainage network are to reduce the volume of run off to the northern area of the site and overall reduce the post development runoff rates via the utilisation of SuDS techniques. This is to ensure that flood risk is overall reduced.

11.140 The surface water drainage design for the site will limit post development runoff rates to significantly less than the pre development rates. The onsite attenuation also includes for increase in rainfall in accordance with the current climate change allowances guidance. As such the development will result in a reduction in the offsite runoff rates.

11.141 As the drainage strategy for the site incorporates a pumped system for the northern catchment. It is considered, and accepted by United Utilities, that the risk of both the duty and standby pumps failing in conjunction with the 1 on 100 year plus climate change volume being mobilised is so low as can be discounted for design purposes.

11.142 If the pumps fail an emergency alarm will notify United Utilities to visit site to repair the pumps.

11.143 The magnitude of the impact of the development on changes in flood risk to new residents is therefore considered moderate beneficial.

11.144 With the drainage strategy in place, the effect on fluvial and surface water flood risk will result in **moderate** to **major beneficial** change from the existing situation with surface water managed via the drainage network and surface water flooding managed within a flood basin (with an inclusion of climate change allowance).

Water Quality

11.145 The day to day operational activities on site could result in the storage of household chemicals and liquids and the presence of automotive fluids on site throughout the operational lifetime of the site. The potential for the impact is considered long term in nature, with the potential present through the operational lifetime of the development; however, an individual impact is considered short term in nature, with only isolated occurrences anticipated.

11.146 As noted in the previous sections, in terms of water quality Mill Brook is considered to be a low sensitivity receptor.

11.147 With the development of the onsite drainage network and the isolated nature of the impact, the likelihood of any spillages reaching the watercourse is negligible. If spillages of chemicals do ingress into the watercourse system, this could result in a temporary adverse effect on the water quality. As the mitigation proposed (surface water drainage networks) reduces the likelihood of spillages entering the watercourse system, the magnitude of the impact will be low.

11.148 The effect on water quality of household/automotive chemicals entering watercourses is therefore considered to be a **negligible**.

Additional Mitigation / Enhancement Measures

11.149 This section describes the measures which are required to mitigate any significant environmental impacts.

Demolition and Construction

Pollution Prevention

11.150 Mitigation would be secured through the production of a CEMP for the Proposed Development, which will be in place to ensure good working practices in line with appropriate standards.

11.151 Mitigation will include the use of appropriate measures as outlined via the Environment Agency's Pollution Guidelines (Gov.uk). Where more detail is required, the now withdrawn Pollution Prevention Guidelines series will be referred to (in the absence of any replacement pollution prevention guidelines).

11.152 Good working principles in line with the now withdrawn Pollution Prevention Guidelines (in particular PPG5) and best practice to reduce the instance of silt laden and or contaminated runoff from the site during the construction period will be adopted. The following measures would be set out within the CEMP and would be implemented;

11.153 For mitigation with respect to stockpiles, exposed ground and sediment:

- Minimise the amount of exposed ground and soil stockpiles from which water drains and the period of time such water drains (any surplus excavated materials would be disposed of off-site as early as possible);
- Gaps would be provided at intervals in the stockpiles to act as overland flow water pathways to ensure that overland flow routes are not hindered and a surface water flooding is not created;
- Only remove vegetation from the area that needs to be exposed in the near future (ensure a vegetated strip would be left adjacent to any watercourses);
- Seed or cover stockpiles;
- All soils will be stored away from watercourses and any potentially contaminated soil would be stored on an impermeable surface and covered to reduce leachate generation and potential migration to surface waters;
- Use of silt fences at the toe of the slopes, made from semi-permeable geotextile fabric, vertically held on timber post, to reduce sediment transportation;
- Use of silt traps on the inlet or outlets side of culverts to reduce sediment transportation;
- Provided lagoons / ponds that allow suspended solids to settle out before disposal; and
- Use of straw bales to filter out sediment from normal flows in drainage ditches, pinned into position to avoid being washed away. Silt laden bales should be discarded in line with relevant waste regulations.

11.154 With respect to on-site working the following measures will be undertaken:

- Ensure that any vehicle or plant washing is carried out on designated areas of hardstanding at least 10m from any watercourse or surface water body;
- Collect run-off from hard standing area in a sump; and

- Ensure settled solids are removed regularly.

11.155 With regards to safe storage and use of concrete and cement, concrete and cement mixing and washing areas should:

- Be sited 10m from any watercourse / waterbody or surface water drain to minimise the risk of runoff entering a watercourse;
- Have settlement and re-circulation systems for water re-use, to minimise the risk of pollution and reduce water usage; and
- Dispose of contained water to either foul sewer if possible, or tanker off site.

11.156 With respect to safe storage and use of oils and chemicals:

- Fuel, oil and chemical storage should be on an impervious base within a secondary containment system such as a bund. The base and bund walls should be impermeable to the solution stored and be able to contain at least 110% of the volume stored;
- The storage facility should be sited at least 10m from any watercourse / waterbody and 50m away from any well, borehole or spring; and
- Appropriate spill kits should be stored in the immediate vicinity of the storage facility and trained staff to utilise in case of incident.

11.157 Mitigation in respect of vehicle and wheel washing on site:

- Vehicle washing and cleaning should be carried out in areas that are clearly marked and isolated from surface water drainage systems, unmade ground and porous surfaces (designated washing bays); and
- A designated washing bay should be designed so that runoff is isolated using channels, gullies, gradients, directed to a silt trap or sediment tank to remove larger particles, and either collected in a sealed system for reuse or authorised disposal or discharged to public foul sewer (subject to approval).

11.158 Mitigation of uncontrolled (and particulate) runoff from construction areas and access tracks:

- Any compounds should, where possible, utilise a wide strip of geotextile laid on the ground covered by a nominal layer of stone to form the compound. Areas of the construction compound such as portacabins, storage systems etc, would result in the potential increase in surface water runoff;
- Generally the compounds will maintain a permeable nature, however as there would be an increase in hard standing, a form of attenuation will be required on site to maintain flow rates at the pre development level;
- Any flows in excess of the infiltration rates will be stored in the attenuation facility and would not effect on land outside of the site. The specifications of the attenuation facility would be determined at the detailed design stage; and

- Where stone is used as a capping layer, the content of the stone should not include a high percentage of fines so as to not increase the risk of sediment contamination of the adjacent area and watercourses.

Land drainage consent and infilling of watercourses

11.159 Any culverting or altering of a watercourse requires land drainage consent. On Main Rivers the prior written consent of the Environment Agency is required under Section 109 of the Water Resources Act 1991. There are no main rivers within the site. On all other watercourses, as is the case here, the LLFA's consent is required under Section 23 of the Land Drainage Act 1991.

11.160 Whilst works are anticipated to the ditch systems within the site, at this stage specific proposals have yet to be identified. Proposals will therefore be agreed with the LLFA at the appropriate time.

Completed Development

Surface Water Drainage

11.161 A surface water drainage strategy has been developed with details of the outline proposals for the surface water drainage strategy contained in the Flood Risk Assessment (included in **Appendix 11.1**). The details of a drainage strategy will be developed as the scheme progresses through the detailed design stage. Infiltration techniques will not be suitable on-site due to the impermeable nature of the underlying ground conditions. Therefore infiltration based SUDS will not be incorporated into the drainage design. In summary the scheme contains the following features:

- Limit surface water discharge rates to less than existing;
- The surface water drainage system will comprise a gravity system to the southern catchment and a pumped system to the northern catchment and which has been agreed by United Utilities in order to mitigate the requirement to raise levels;
- Surface water attenuation will be provided via an attenuation basin and swale system to the southern catchment and a pipe system to the northern catchment with flows to be contained up to the 100 year plus 40% climate change rainfall event; and
- A flood storage basin will be formed in the northern area of the site.

11.162 To ensure the watercourses and ditch network are sufficiently protected, mitigation will be embedded into the design:

- The northern boundary culvert located just beyond the site boundary will be remain substantially accessible across existing open space;
- The ditch network will be contained within the proposed green corridors on site, ensuring that the built development is set back from the top of bank, limiting any potential impacts during construction and operation; and

- All proposals for the crossings of the watercourses will be sized to ensure that flows are not restricted and there is no impact on flooding upstream.

Foul Drainage

11.163 It is not envisaged that the foul drainage proposals will have any impact.

Likely Residual Effects of the Development and their Significance

11.164 An assessment of the significance of the effects likely to arise as a result of the development after embedded mitigation and further mitigation and enhancement measures have been employed is included at the end of the chapter in Table 11.5.

11.165 A Flood Risk Assessment has been carried out on this Site and an assessment of potential effects on the receptive watercourse system and other hydrological elements has been carried out. The ditch/watercourse networks onsite/adjacent to the site boundary vary in sensitivity with respect to flood risk. Were a development to go ahead without suitable mitigation (embedded or additional) there is potential for significant negative effects on existing development in terms of flood risk.

11.166 Mitigation in the form of SUDs and a flood storage basin will ensure that the proposed development will have **moderate to major beneficial** impact. Furthermore, an appropriately detailed CEMP (including a Pollution Prevention Plan), will be developed and agreed with the LLFA during the reserved matters application process prior to commencement on site to ensure there are no significant negative effects on these watercourses.

11.167 Comprehensive biodiversity enhancements throughout the Site through the development of the SuDS drainage network will ensure that water quality is not compromised. The development will also ensure that ecological value, ecosystem service value and benefit to human health and wellbeing is increased and represents a residual positive effect resulting from the biodiversity enhancements.

Table 11.5: Residual Effects Summary

Description of Effect	Significance	Mitigation	Residual Effect
Construction and Demolition			
Flood Risk to construction activities and the site	Major Beneficial	Embedded and surface water drainage strategy	Major Beneficial
Flood Risk to surrounding areas during construction	Moderate Beneficial	Embedded and surface water drainage strategy	Moderate Beneficial

Description of Effect	Significance	Mitigation	Residual Effect
Infilling of and diverting existing ditches impacting upon flood storage	Moderate beneficial	Embedded Mitigation	Moderate beneficial
Infilling of and diverting existing ditches impacting upon flood risk	Moderate beneficial	Embedded Mitigation	Moderate beneficial
Sedimentation of Mill Brook impacting upon channel capacity and flood risk	Minor beneficial	Embedded Mitigation and Pollution Prevention Guidance good practice principles	Minor beneficial
Sedimentation of Mill Brook tributary and culverts upon channel capacity and flood risk	Minor beneficial	Embedded Mitigation and Pollution Prevention Guidance good practice principles	Minor beneficial
Debris deposition into watercourses increasing culvert blockage risk and flood risk.	Minor beneficial	Embedded Mitigation and Pollution Prevention Guidance good practice principles	Minor beneficial
Debris deposition into watercourse/ditch network increasing blockage risk and flood risk.	Minor beneficial	Embedded Mitigation and Pollution Prevention Guidance good practice principles	Minor beneficial
Sedimentation of watercourse/ditch network impacting upon water quality	Negligible	Pollution Prevention Guidance good practice principles	Negligible
Spillages of fuels and chemicals into watercourse/ditch network impacting upon water quality	Moderate Adverse	Pollution Prevention Guidance good practice principles	Negligible
Spillages of cements and concretes into watercourse /ditch network	Negligible	Pollution Prevention Guidance good practice principles	Negligible

Description of Effect	Significance	Mitigation	Residual Effect
Inappropriate disposal of foul waste to watercourse/ditch network	Minor Adverse	Pollution Prevention Guidance good practice principles	Negligible
Completed Development			
Surface Water Drainage Network	Major Beneficial	Embedded Mitigation, Surface Water Drainage Strategy (reduction in pre development run off rates.	Major Beneficial
Foul Drainage Network	Negligible effect	None required	Negligible effect
Changes to flood risk for the New Local Population	Moderate to Major Beneficial	Embedded Mitigation	Moderate to Major Beneficial
Changes to flood risk for the Existing Local Population	Moderate to Major Beneficial	Embedded Mitigation	Moderate to Major Beneficial
Surface water flood risk	Minor Beneficial	Embedded Mitigation, Surface Water Drainage Strategy (reduction in run off rates)	Minor Beneficial
Spillages of household chemicals and liquids into the surface water drainage network and bounding watercourses	Negligible	Surface Water Drainage Strategy	Negligible

Conclusions

11.168 The risks associated with the following have been identified and addressed:

- Mill Brook, northern culvert and general surface water and groundwater flooding;
- Penwortham Way;
- Development drainage proposals; and
- Development land drainage proposals.

11.169 Existing properties and lanes will be retained within the overall development proposals and ultimately drain into the existing drainage network either overland or via direct connections.

11.170 The site is underlain by boulder clay and ground conditions which will be unsuitable for surface water infiltration-based drainage.

11.171 Two main surface water outfalls from the development area are proposed, to the northern tributary boundary culvert and the second, direct to the same system where it crosses Penwortham Way to the north west, downstream of Kingsfold.

11.172 The area most vulnerable to surface water flooding lies to the northern area of the site and relies for drainage on the northern tributary culvert which flows through the adjacent Kingsfold development. It is proposed to both redirect flows into this system from upstream to downstream of the existing development and to also overall reduce run off from the site.

11.173 Surface water flows will be attenuated onsite within an attenuation basin and swale system and, to the northern area, within a pumped pipe system. Overall flows will be contained on site up to the 1 in 100-year event plus allowance for 40% climate change.

11.174 The existing land drainage system will be maintained, upgraded and diverted as necessary to ensure that land drainage flows, including flows from the lanes and property to be retained, continue to drain via land drainage corridors independently of the main pipe systems into the basins and swales systems.

11.175 Overall development levels will be set to create overland flow paths to ensure that there is no increased risk of surface water flooding to existing property and, where achievable, any existing risk is mitigated.

11.176 Ground conditions preclude infiltration, limiting opportunities to address water quality. However, the risks associated with residential housing range from low to very low.

11.177 Notwithstanding trapped gully systems to roads and the basin and swale system will achieve up to two levels of treatment to a substantial part of the development to address any perceived risk to water quality.

11.178 An assessment of the potential effects upon flood risk, drainage and water quality at the site has been undertaken within this statement to accompany the Flood Risk Assessment. The assessment has concluded that following the incorporation of the embedded mitigation measures, flood risk to the development site and surrounding area has been reduced.

11.179 Due to the low flow nature of the existing ditch network the effects of any deposition of silts and spillages of contaminants are likely to be highly localised and readily remediated. Such occurrences will be reduced by adoption of the CEMP.

11.180 Following the mitigation measures described, the residual impact of the proposed development would have a **negligible** effect upon flood risk and drainage in many cases, with a **minor beneficial** effect in a number of cases. **Moderate** to **major beneficial** effects are also anticipated with regards to the surface water drainage network and changes to flood risk on site and in the surrounding area.