

Building 401 Redevelopment

Level 2 Flood Risk Assessment

Columbia Threadneedle Investments

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Glossary

AEP	Annual Exceedance Probability
DRN	Detailed River Network
EA	Environment Agency
FMfP	Flood Map for Planning
FRA	Flood Risk Assessment
Ha	Hectare
LPA	Local Planning Authority
NPPF	National Planning Policy Framework
PPG	Planning Practice Guidance
LLFA	Lead Local Flood Authority
MCC	Manchester City Council
MAG	Manchester Airport Group
LiDAR	Light Detection and Ranging
OSNGR	Ordnance Survey National Grid Reference
UU	United Utilities

Common Terms

Flood Zone	Environment Agency defined zone of flood risk used for planning
Main River	Main rivers are usually larger rivers and streams. The EA carries out maintenance, improvement or construction work on main rivers to manage flood risk.
Ordinary Watercourse	Ordinary watercourses include every river, stream, ditch, drain, cut, dike/dyke, sluice, sewer (other than a public sewer) and passage through which water flows and which does not form part of a main river.

1. Introduction

AECOM has been commissioned by Columbia Threadneedle Investments (CTI) to produce a Level 2 Flood Risk Assessment (FRA) in support of the planning application for a logistics development on the site of the former Building 401 at Manchester Airport adjacent to Pinfold Lane and Wilmslow Old Road.

A Level 2 FRA is a qualitative appraisal of the flood risks posed to a site and the potential impacts development could have on flood risk elsewhere, providing recommendation of possible measures to reduce the level of flood risk, where necessary. This Level 2 FRA report has been prepared in accordance with National Planning Policy Framework (NPPF)¹ and the associated Planning Practice Guidance (PPG)².

This FRA is based on the best available flood risk information available at the time of writing. Data has been provided by the Environment Agency, United Utilities and other external sources.

1.1 Description of the Proposed Site

The proposed development site is located to the North of Wilmslow Old Road and west of Pinfold Lane as shown in Figure 1-1. The Ordnance Survey National Grid Reference (OSNGR) for the site is 381009, 384731. Vehicular access to the site is via Pinfold Lane which runs along the sites most north eastern boundary.

One tributary of Cotteril Clough Brook Ordinary Watercourse sit around 170 metres from the site before converging with another tributary and flowing in a south westerly direction prior to discharging into the River Bollin.

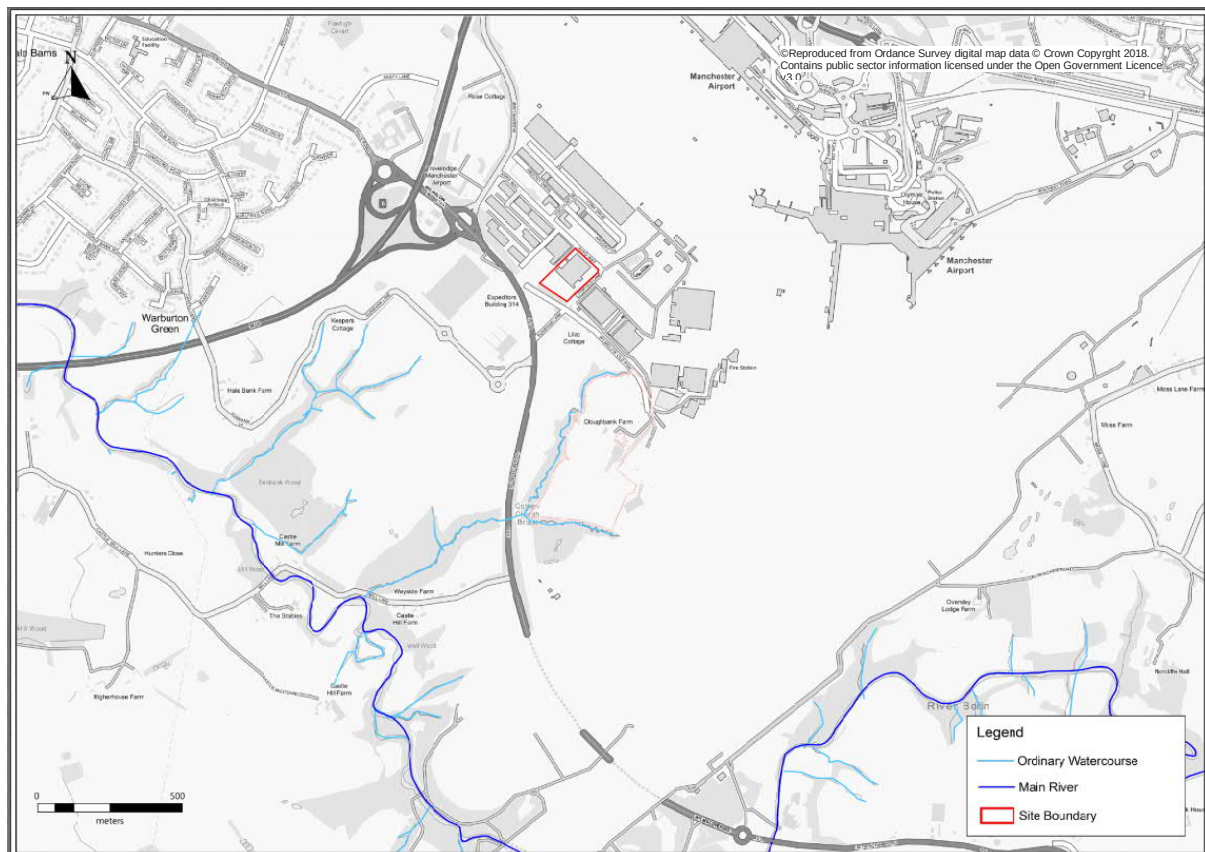


Figure 1-1 Proposed Site Location Plan

The site is currently owned by Columbia Threadneedle Investments. The site has been classified as Brownfield for the purpose of this FRA due to previous site usage.

¹ Department for Communities and Local Government (2018) *National Planning Policy Framework*. London.

² Department for Communities and Local Government (2018) *Planning Practice Guidance: Flood Risk and Coastal Change*. London

1.2 Topography

Figure 1-2 shows the topography of the site, as demonstrated by LiDAR. Review of the LiDAR suggests that the site is considered to be relatively flat. The highest elevation is indicated to be approximately 70m Above Ordnance Datum (AOD).

As indicated by the LiDAR, approximately 2 kilometres (km) to the east of the site boundary, the topography gently increases up to an elevation of 90 mAOD. Immediately south of the site, land levels fall southwards towards the low lying floodplains of the River Bollin.

Review of the outline design drawings and the Environment Agency Flood Map for Planning (FMfP)³ suggests the site is approximately 2.6 hectares (ha) in area and located in Flood Zone 1. The NPPF and associated PPG specify that any newer development greater than 1 ha and located in Flood Zone 1 must be supported by a site-specific FRA.

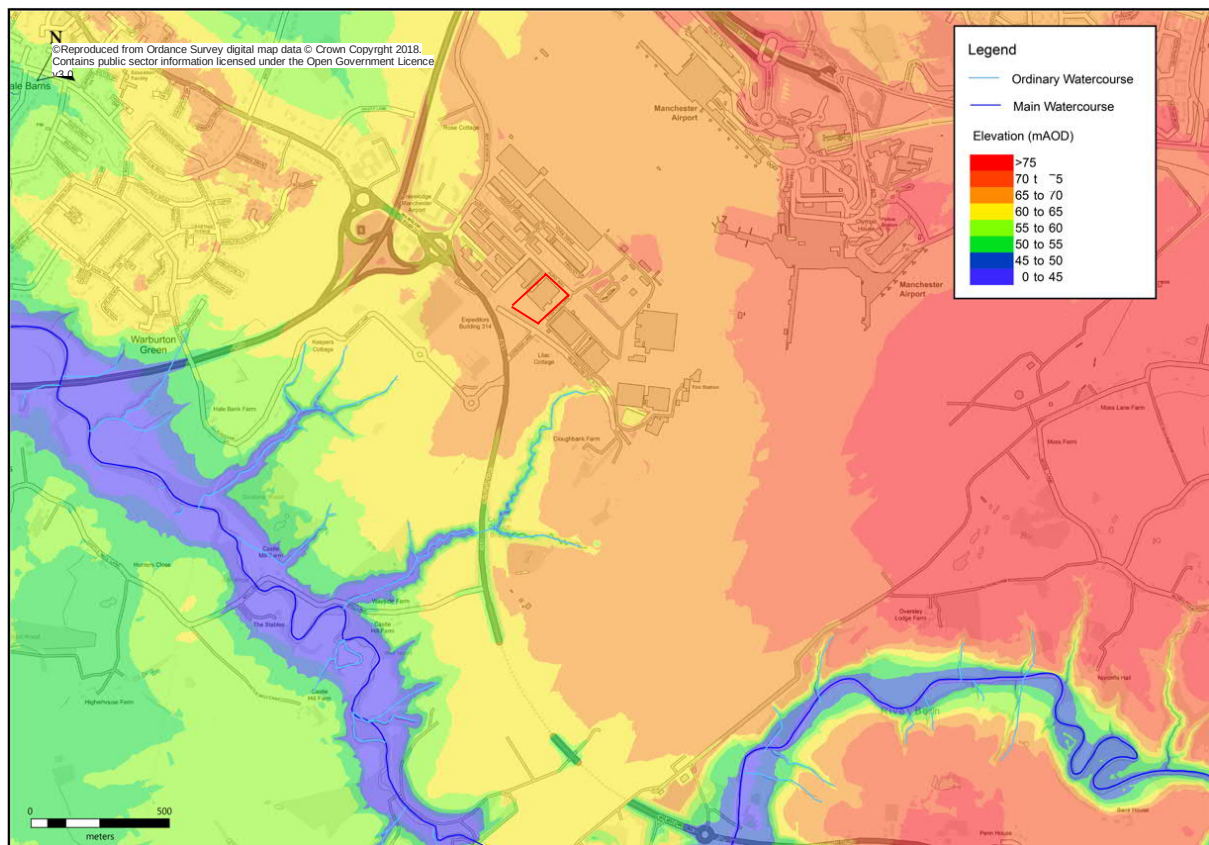


Figure 1-2 Topography (LiDAR) surrounding the site

1.3 Description of the Proposed Works

The proposed development is a logistics warehouse along with two storey office building and associated external areas the proposed site will contain:

- New logistics warehousing
- Integral Offices
- External service yards
- Car Parking
- Landscaping to boundary
- Drainage + Infrastructure

A layout plan for the proposed development is presented in Appendix A.

³ Environment Agency (2018) Flood Map for Planning: Rivers and the Sea. Online. Available at: <https://flood-map-for-planning.service.gov.uk/>

2. Evaluation of Flood Policy

2.1 National Planning Policy

Section 14 of the 2018 updated National Planning Policy Framework (NPPF) and the 2014 Flood Risk and Coastal Change Planning Practice Guidance (PPG) both advise how the planning process can take account of the risks associated with flooding. Table 2⁴ of the PPG describes flood vulnerability classifications associated with broad types of development and suggests the proposed development is considered to be 'General Industry', which is classified as being 'Less Vulnerable' to the effects of flooding.

Table 3⁵ of the PPG provides a matrix style appraisal of the suitability of development (based on its vulnerability) to placement within the different Flood Zones. In accordance with Table 3, 'Less Vulnerable' developments are permitted in Flood Zones 1, 2 and 3a. The proposed Car Park and Motor Transport Building / Bus Maintenance Area is therefore considered to meet the requirements of the Sequential Test.

As part of the FRA, the NPPF requires that developers consider not just the flood risk to the development but also the impact that the proposed development might have on flood risk elsewhere. As well as fluvial and coastal flooding, it is also necessary to consider flood risk from all other sources, including surface water, groundwater, ordinary watercourses, and artificial drainage systems and infrastructure failure. However, in this instance it is important to note that coastal flooding has not been assessed, as the site is located approximately 30 km from the sea (Mersey Estuary).

2.2 Regional & Local Planning Policy

Manchester City Council (MCC) are the Lead Local Flood Authority (LLFA) and the Local Planning Authority (LPA) within the vicinity of the proposed development and therefore have responsibility for the management of development and flood risk; alongside, the responsibility for the preparation of local plans and policies to manage flooding.

2.2.1 Manchester City Council Core Strategy

The Manchester City Council Core Strategy⁶ was adopted in the 11th July 2012 and sets out planning policies for the district up to 2027. This strategy supersedes the Unitary Development Framework and includes updates to the long term strategic policies for developments in Manchester and forms the framework that planning applications will be assessed against.

Relevant district wide policies with regards to development, flood risk and surface water management within the Core Strategy have been reviewed. These policies include:

Policy EN 14: Flood Risk

- *"In line with the risk-based sequential approach contained within PPS25, development should be directed away from sites at the greatest risk of flooding, and towards sites with little or no risk of flooding; this should take account of all sources of flooding identified in the Manchester-Salford-Trafford Strategic Flood Risk Assessment (SFRA).*
- *In addition to the requirements for site-specific Flood Risk Assessments (FRAs) set out in PPS25, an appropriate FRA will also be required for all development proposals, including changes of use, on sites greater than 0.5 ha within Critical Drainage Areas (CDAs) and Canal Hazard Zones identified in the SFRA.*
- *All new development should minimise surface water run-off, including through Sustainable Drainage Systems (SUDS) and the appropriate use of Green Infrastructure. Developers should have regard to the surface water run-off rates in the SFRA User Guide. In CDAs, evidence to justify the surface water run-off approach / rates will be required.*

⁴ Environment Agency (2018) Flood Risk and Coastal Change, Table 2 [online] Available from <https://www.gov.uk/guidance/flood-risk-and-coastal-change#Table-2-Flood-Risk-Vulnerability-Classification>.

⁵ Environment Agency (2018) Flood Risk and Coastal Change, Table 3 [online] Available from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/575184/Table_3_-_Flood_risk_vulnerability_and_flood_zone_compatibility.pdf.

⁶ Manchester City Council (2012) Manchester's Local Development Framework, Core Strategy Development Plan Document

- *The City of Manchester contains many sections of rivers which are culverted or 'hidden'; [...] where feasible and appropriate development should seek to open up culverted/hidden rivers to reduce the associated flood risk and danger of collapse [...]."*

Policy EN 8: Adaptation to Climate Change

"All new development will be expected to be adaptable to climate change in terms of the design, layout, siting and function of both buildings and associated external spaces. In achieving developments which are adaptable to climate change developers should have regard to the following, although this is not an exhaustive list:

- *Minimisation of flood risk by appropriate siting, drainage, and treatment of surface areas to ensure rain water permeability"*

Policy EN 17: Water Quality

"With reference to the Manchester-Salford-Trafford SFRA and other relevant documents:

- *Development should minimise surface water run-off from development and associated roads, and maximise the use of appropriate sustainable drainage systems, to minimise groundwater contamination, and to avoid pollutants reaching watercourses"*

2.2.2 Preliminary Flood Risk Assessment (PFRA)

The purpose of a PFRA document is to provide a high-level summary of significant flood risk, based on available and readily derivable information, describing both the probability and harmful consequences of past and future flooding. MCC as the LLFA have produced a PFRA⁷ in 2011 which considers flooding from; surface water, groundwater, ordinary watercourses, canals and sewer flooding plus any interaction these may have with main rivers across their administrative area. An addendum⁸ to the PFRA was added in December 2017 following a review by MCC of the flood risk area in 2017 using updated surface water mapping a methodology. No updates have been identified to the PFRA since the review of new information.

The PFRA identified 10 national 'Indicative Flood Risk Areas' based on the Flood Map for Surface Water (FMfSW) and flood risk thresholds. The proposed development site is not identified as being within one of the identified 'Indicative Flood Risk Areas'.

2.2.3 Strategic Flood Risk Assessment (SFRA)

The SFRA analyses the flood risk from multiple sources associated with three administrative boundaries: Manchester, Salford and Trafford, who updated their Level 2 SFRA⁹ in 2011. The proposed development site falls within the Manchester administrative boundary. A SFRA is a required evidence document to inform future development, in particular the Local Authorities' Core Strategies, with the purpose of enabling flood risk to be considered at the earliest stage of the planning process. For MCC it is reported that the main sources of flood risk are fluvial flooding and surface water flooding, although areas are also at risk from canal sources.

The SFRA notes there is a low risk of localised surface water flooding to the Airport site (M0007) where the proposed development is located. This area is predominantly at risk from surface water sources with a secondary risk from fluvial sources. The SFRA concludes that careful management of surface water run-off is crucial in this area but overall the area is considered to be at low risk of localised surface water flooding and development within this area will be acceptable subject to a site-specific Flood Risk Assessment (FRA). However, it is stated that any development in the area should look to incorporate SuDs to mitigate run off. Run off rates should not increase as a result of development and where possible, a betterment of the existing run off rate should be sought.

The SFRA also defines several Critical drainage Areas (CDAs) based on surface water flood risk data. These are areas where there is a localised risk of flooding from ordinary watercourses, including culvert surcharging, overland surface water flows, as well as flooding from the sewer network. The proposed development is located within the Manchester and Trafford South CDA where there are predicted to be, on average, between 5 and 20 properties at risk per 0.25 km². Climate change shows a general increase in the number of properties at risk. Surface water run-off from these sites should not increase as a result of development (reduced run-off should be sought if possible in some areas) and not discharge into the combined sewer system.

⁷ JBA (2011) Preliminary Flood Risk Assessment

⁸ Manchester City Council (2017) Preliminary Flood Risk Assessment [online] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/698404/PFRA_Manchester_City_Council_2017.pdf.

⁹ JBA (2011) Manchester City, Salford City and Trafford Councils Level 2 Hybrid SFRA

The SFRA proposes a suite of options be used for surface water management in order to provide a holistic approach. These include measures such as SuDs, Green Infrastructure and increasing capacity of sewers and watercourses.

2.2.4 Local Flood Risk Management Strategy (LFRMS)

In the capacity as an LLFA and following the Flood and Water Management Act 2010, Manchester City Council (MCC) produced a LFRMS¹⁰ (2014) and subsequent Action Plan to provide an overview and assessment of local flood risk throughout Manchester.

The LFRMS sets out its objectives to “*reduce the likelihood, severity and consequences of flooding from Ordinary Watercourses, from Groundwater, and from Surface Water Runoff*”. In order to achieve this the LFRMS highlights that any new development should incorporate appropriate mitigation and/or resilience measures to prevent the increase of flood risk on or off-site.

Following a review of this document, there are no areas of notable risk identified within the proposed site boundary.

2.3 Other Relevant Studies and Reports

2.3.1 Greater Manchester Surface Water Management Plan

A Strategic Assessment of Surface Water Flood Risk (Stage 1)¹¹ was conducted by JBA in 2012 on behalf of MCC. This report looked to identify potential areas of significant risk (‘surface water hotspots’) and produced a strategic flood map. The report reviewed records of historical surface water flooding around the region, using the PFRA, SFRA, flood maps and records. The proposed development site has no record of significant historical surface water floods.

2.3.2 Upper Mersey Catchment Management Plan

The Upper Mersey Catchment Flood Management Plan (CFMP)¹² was produced in 2009 and includes the River Bollin which runs past the southern side of the proposed site boundary.

The Upper Mersey has historically suffered sudden, intense flooding most notably from fluvial sources, however also from surface water, sewers and groundwater. Flood risk in the catchment is currently managed through engineering schemes installed over the last 30 years as well as activities to decrease the probability and consequences of flooding.

No flooding specifically the site but site is covered under Policy 4:

“Areas of low, moderate or high flood risk where we are already managing the flood risk effectively but where we may need to take further actions to keep pace with climate change”

¹⁰ Manchester City Council (2014) Local Flood Risk Management Strategy. Available online [https://secure.manchester.gov.uk/downloads/download/5603/lfrms_documents]. Accessed 20/08/2018

¹¹ Greater Manchester Surface Water Management Plan (2012) Stage 1 – A Strategic Assessment of Surface Water Flood Risk. [online] Available from: <https://www.bury.gov.uk/CHttpHandler.ashx?id=11439&p=0>. Accessed 22/08/2018

¹² Environment Agency (2009) Upper Mersey Catchment Flood Management Plan. [online] Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/293774/Upper_Mersey_Catchment_Flood_Management_Plan.pdf. Accessed 22/08/2018

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3. Assessment of Flood Risk

This section of the report considers the potential risks posed to the proposed development from all sources of flooding. Where a flood risk is considered 'moderate' or 'high', then mitigation measures may be required, which will be discussed in Section 5.

3.1 Flood Risk from Fluvial Sources

Fluvial flooding occurs when the capacity of a river is exceeded either due to high flows from the catchment draining into the river or a combination of high flows and high tides, which causes the river to overflow or overtop its banks.

3.1.1 Flood Risk from Main Rivers

Review of the Environment Agency Flood Map for Planning (FMfP) shows the proposed development site to be located in Flood Zone 1, which represents land classified as being at low risk (less than 1 in 1,000 Annual Exceedance Probability (AEP)) of flooding from rivers and sea (Refer to Figure 3-1).

The Environment Agency Detailed River Network (DRN) shows that the River Bollin is classified by the Environment Agency as a Main River. The River Bollin rises in Macclesfield Forest at the western edge of the Peak District and flows westerly for approximately 3.8km before passing the site, approximately 0.6km south of the site's southern boundary. The river continues westwards for approximately 10 km before discharging into the River Mersey via the Manchester Ship Canal.

Whilst the River Bollin is situated approximately 1.31km from the site, a review of the FMfP suggests that the site is located outside of the likely extent of flooding from the river. Furthermore, a review of the topography suggests the proposed site is at 35m higher than the river and there are likely to be no plausible flow routes between the proposed site and the river.

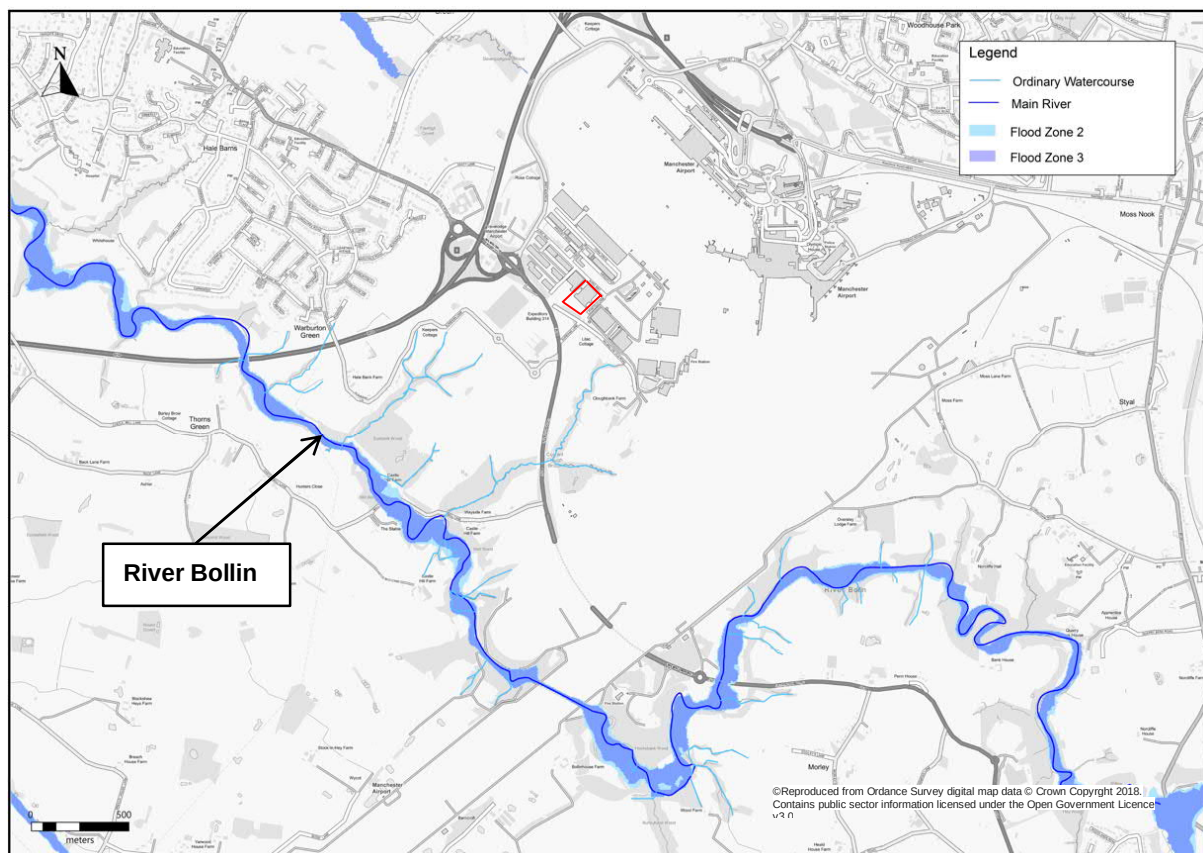


Figure 3-1 Environment Agency Flood Map for Planning

The site is therefore considered to be at low risk of flooding from Main Rivers and no mitigation is required.

3.1.2 Flooding from Ordinary Watercourses

Following review of Ordnance Survey (OS) mapping and aerial photography, the closest ordinary watercourse to the site is Cotteril Clough Brook, a tributary of the River Bollin. Cotteril Clough has two branches, both of which

originate within the MAG site with the closest being 170 metres from the site. The watercourses are thought to take much of the outflow from the MAG Airport Drainage network. The two branches merge as they pass beneath Wilmslow Road (A538), before discharging into the River Bollin 0.6 km downstream.

Given the proximity of these features to the site, there is a risk of Ordinary Watercourse flooding to the site. Furthermore, as the watercourses hold Ordinary Watercourse status, no detailed flood mapping is available from the Environment Agency and the flood extents from this watercourse remains unknown. However, based on consultation with the design team, the proposed Finished Ground Levels (FGL) for the site will be approximately 7m above the river bed. In addition, the site drainage will be designed for a 100 year event with appropriate attenuation provide. As a result, the risk of flooding to the site is considered to be low but a residual risk of flooding still remains, refer to Section 5.5.

3.2 Flood Risk from Surface Water

Surface water runoff is defined as water flowing over the ground that has not yet entered a drainage channel or similar. An intense period of rainfall, which exceeds the infiltration capacity of the ground usually results in surface water runoff. Typically, runoff occurs on sloping land or where the ground surface is relatively impermeable. The ground can be impermeable either naturally through the soil type or geology or unnaturally due to development, which places large areas of impervious material over the ground surface (e.g. paving and roads).

Following a review of the Environment Agency Risk of Flooding from Surface Water (RoFfSW) dataset, the area around the proposed site is considered to be at high risk of flooding in a 3.33% AEP event. However, following a review of the flood extents within the site boundary, there are only a limited number of locations at risk from flooding. These include a small area of flooding near to the buildings in the North-east of the site which are at risk of flooding in the 3.33% AEP event (refer to Figure 3-2).

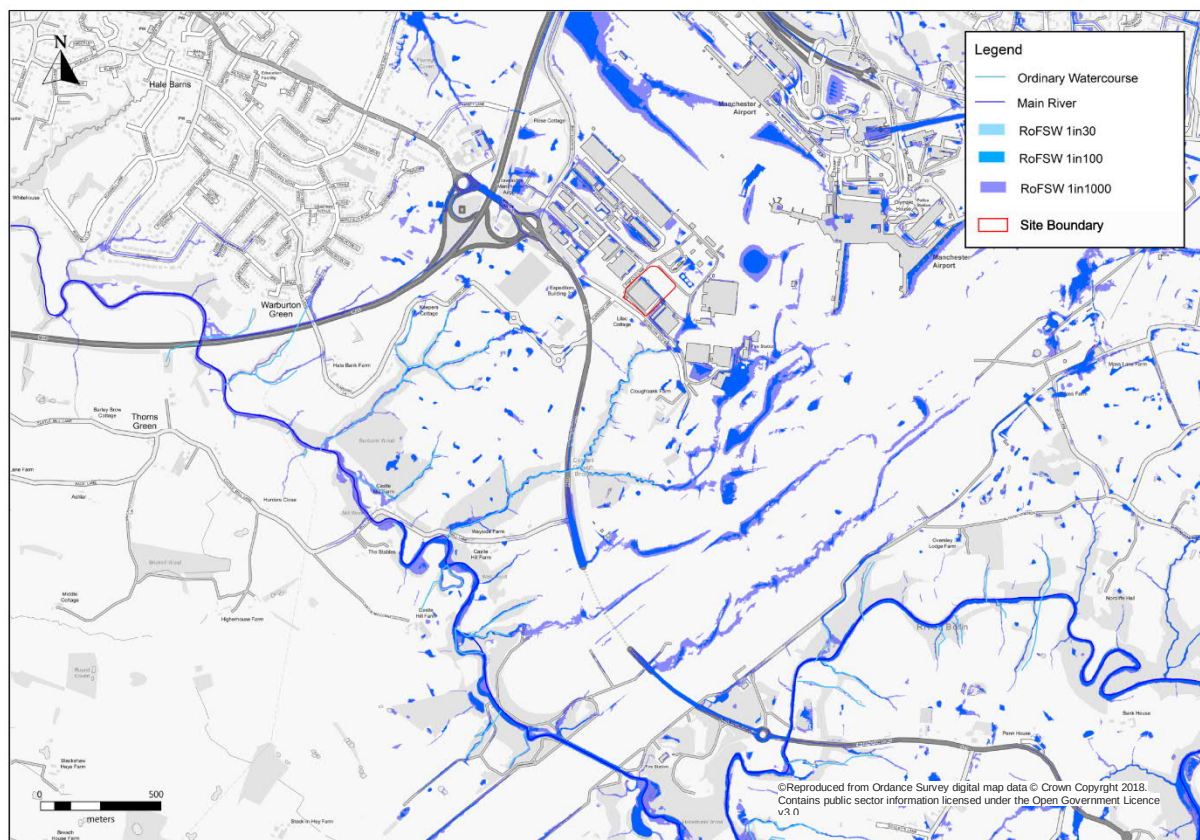


Figure 3-2 Environment Agency Risk of Flooding from Surface Water

Additionally, the development site is considered to be within the Manchester and Trafford South Critical Drainage Area, and is known to suffer from surface water flooding. This is supported by the review of the SWMP, which mentioned the Airport and its surrounding areas as being at risk from surface water flooding. However, consultation with the design team suggests that the proposed development will include a below ground drainage system which will be designed to accommodate the 1 in 100 year plus 40% climate change flows. As such, any surface water flooding at the site is likely to be intercepted by this drainage system and attenuated within the site before being

discharged into the Bollin Outfall Sewer which is around 20 metres deep and offers significant capacity transferring flows directly to the River Bollin.

As a result, the risk of flooding to the development from surface water is considered to be low and no further mitigation in addition to that included with the site design is likely to be required.

3.3 Flood Risk from Ground Water

Groundwater flooding occurs when the natural level of water stored within the ground rises above local ground level. This can result in deep and long-lasting flooding of low lying or belowground areas such as underpasses and basements. It tends to occur after long periods of sustained high rainfall, and the areas at most risk are often low-lying where the water table is more likely to be at a shallow depth. Groundwater flooding is most likely to occur in areas underlain by major aquifers, although it is also associated with more localised floodplain sands and gravels.

Based on the SI undertaken for the site ground water is not encountered until 3.5 metres deep with some perched water in the glacial material under the former Hangar slab.

A review of British Geological Survey¹³ (BGS) data shows that the site is underlain by Bollin Mudstone with superficial deposits recorded as Devensian Till. Mudstone is generally characterised by being particularly impermeable bedrock. According to the Environment Agency Flood Map for Planning (Groundwater)¹⁴ the site is a Secondary B Bedrock aquifer.

Given the conflicting evidence, the flood risk is considered to be medium. However, the permanent infrastructure will be constructed above the water table with appropriate DPM provided. It is therefore not deemed that the structures need to be designed to resist hydrostatic pressure.

3.4 Flood Risk from Sewer and Water Supply Infrastructure

Sewer and surface water flooding are often interconnected especially in combined sewer systems; insufficient drainage capacity in the sewer network can result in extensive surface water flooding and, by the same rationale, large volumes of surface water can overload the public sewers, causing the sewer network to back up, surcharge and ultimately cause flooding above ground level.

3.4.1 Public Sewer Network

The United Utilities (UU) public sewer network is shown in Figure 3-3 and indicates that the Bollin Outfall Sewer runs adjacent to the site within the DNATA site on the opposite side of Pinfold Lane. This is the main clean outfall for the airfield and is around 20 metres deep with a large redundant capacity available and therefore the risk from this sewer is deemed to be very low.

Following review of the Drainage Strategy contained within Appendix B, the proposed development will incorporate a drainage system suitable for attenuating flows up to and including the 1 in 100 year plus 40% climate change event. Therefore, in the event of exceedance of this public sewer system any flows which enter the site from the surrounding area should be captured and attenuated by this network. As such, the risk to the site from the private sewer network is considered to be low and no further mitigation is required.

¹³ British Geological Survey (2018) Geology of Britain Viewer. Online. <http://www.bgs.ac.uk/discoveringGeology/geologyOfBritain/viewer.html> Accessed: 22/08/2018

¹⁴ Environment Agency (2018) Flood Map for Planning: Groundwater. Online. <http://maps.environment-agency.gov.uk/wiyby> Accessed: 22/08/2018

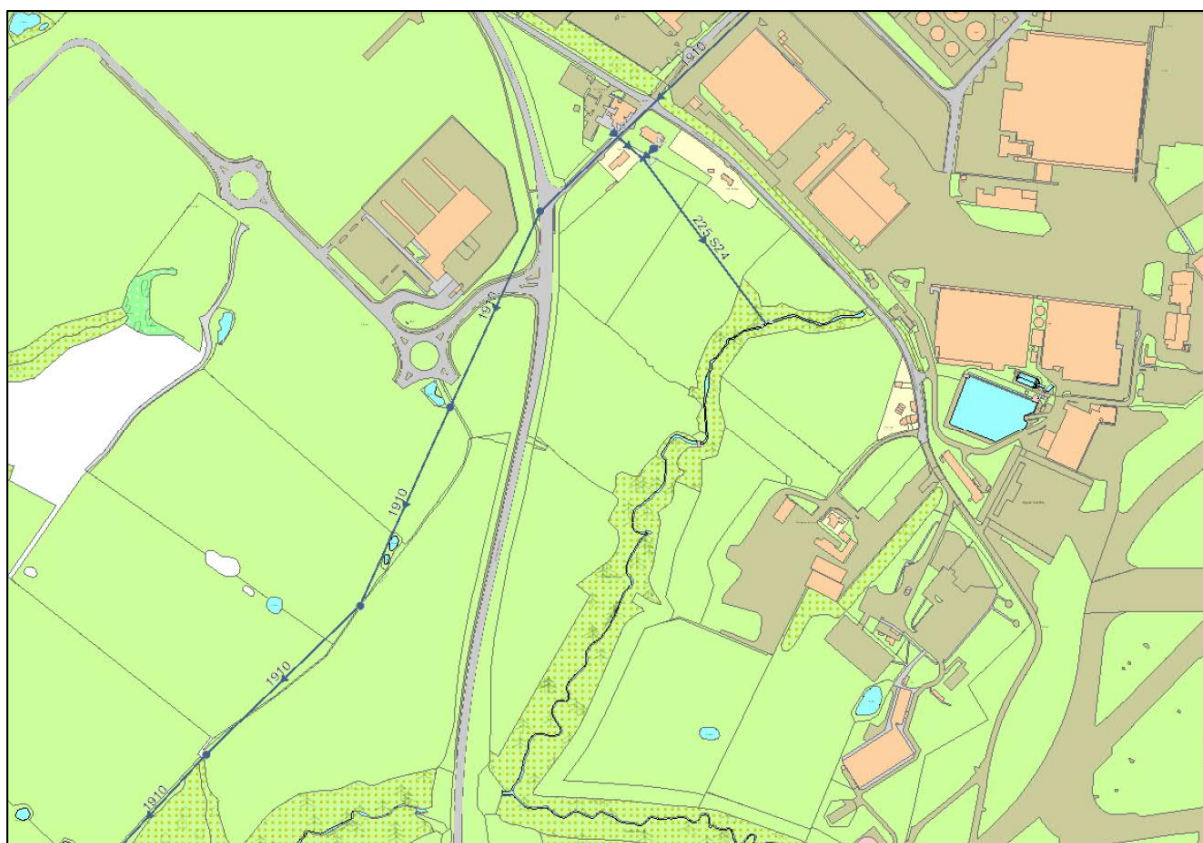


Figure 3-3 United Utilities Public Sewer Network

3.4.2 Private Sewer Network

Following a review of the private MAG drainage plans for the Manchester Airport site, a significant proportion of the Manchester Airport surface water drainage network discharges via piped outfall into the western tributary of the Cotteril Brook Ordinary Watercourse. Figure 3-4 shows the culvert outfall from this drainage network into the Cotteril Brook. Given the size of this outfall and the resulting network drained, there is the potential for surface water flows from this drainage network to increase the risk of fluvial flooding from the Cotteril Brook Ordinary Watercourse.

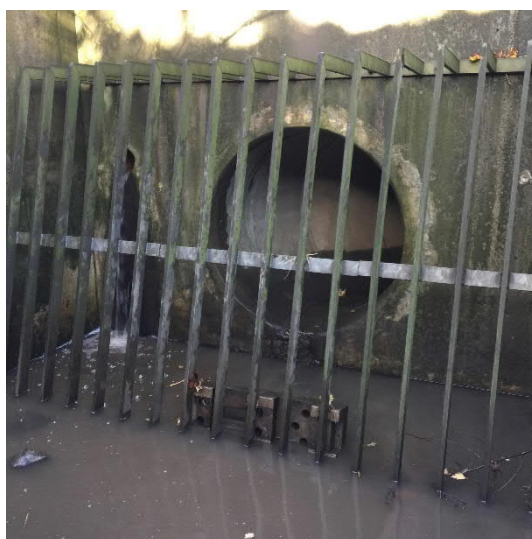


Figure 3-4 Culvert outfall from Manchester Airport Site into Cotteril Brook

However, a review of the topography surrounding the Cotteril Brook Ordinary Watercourse suggests that the watercourse is at a significantly lower elevation than the proposed development site. Following consultation with the design team, the lowest elevation within the site boundary is approximately 7m higher than the bed level of the watercourse. Based on the evidence supplied, the risk of flooding to the site from the private airport drainage network is considered to be low.

3.5 Flood Risk from Canal Systems

A review of Ordnance Survey mapping indicates that there are no canal systems within close proximity to the proposed development site. As such, the risk of flooding from canal systems is considered to be low and no mitigation is required.

3.6 Flood Risk from Reservoirs

Reservoir failure can be particularly dangerous as it causes the release of large volumes of water at a high velocity, which can result in deep and widespread flooding. However, reservoir inspection and design procedures are very rigorous such that the probability of failure is generally regarded as extremely low.

In accordance with the Environment Agency's flood map showing 'Risk of Flooding from Reservoirs'¹⁵ the site is located outside of the extent of reservoir flooding. However, a review of aerial mapping suggests that Ross Mere natural reservoir located approximately 3 km south of the site and discharges via ordinary watercourse into the River Bollin, approximately 1.6 km upstream of the site. However, in the unlikely event of failure, flood flows would be channelled into the low lying River Bollin River Valley (lying approximately 34.5 mAOD below the site) and away from the proposed development.

3.7 Flood Risk from Land Drainage Systems and Flood Risk Management Infrastructure

A review of the FMfP suggests there are no flood defences close to the development site and no land drainage features can be observed on aerial mapping.

The risk to the Site from the failure of artificial drainage systems is therefore considered to be low and no mitigation is required.

¹⁵ Environment Agency 2014, Available at: <http://maps.environment-agency.gov.uk> [Accessed 08th August 2018]

3.8 Summary of Flood Risks to the Proposed Development

Table 3-1 Summary of Key Flood Risks to the Proposed Development

Flood Risk	Summary of Risk to Development Site (High / Medium/ Low)	Notes	Mitigation Required
Fluvial	Low	The site is located in Flood Zone 1 and is therefore at low risk of flooding from Main Rivers. Cotteril Brook Ordinary Watercourse forms the sites western and southern boundary and could pose a risk to the development. However, the site is elevated 4 m above the watercourse. There is a residual risk of flooding to the site from Ordinary Watercourse flooding.	No
Surface Water	Low	Following a review of the Environment Agency Risk of Flooding from Surface Water (RoFfSW) dataset, there are some small, localized areas of surface water flooding within the site boundary. However, the development will contain a below ground drainage network which is through to adequately mitigate this risk.	No
Groundwater	Low	There are a number of local features including small watercourses and a pond which could indicate elevated ground water levels at the site. However, providing any below ground elements are designed to withstand hydrostatic pressure, the risk to the development from ground water flooding is considered to be low.	No
Sewer and Water Supply Infrastructure	Low	Whilst there are public sewers within close proximity of the site, exceedance flows from these systems would likely to be captured by the proposed drainage network. There is also a risk to the site from the MAG drainage network, however, the site is sufficiently elevated above this watercourse such that the risk is considered to be low.	No
Reservoir	Low	The site is located outside of the extent of reservoir flooding. However, aerial mapping suggests that there is a commercial Reservoir located approximately 40m north of the site. As this is commercially managed, it has been assumed that this reservoir is subject to regular inspection and maintenance regimes.	No
Canal	Low	A review of Ordnance Survey mapping indicates that there are no canal systems within close proximity to the proposed development site.	No
Artificial Drainage Systems and Flood Risk Management Infrastructure	Low	There are no artificial drainage systems and flood risk management infrastructure located in close proximity to the site.	No

4. Impacts of the Development on Flood Risk

4.1 Impact of Fluvial Flooding

It is possible that the proposed development could have an impact on fluvial flooding due to an alteration of flood mechanisms and flows and through an increase in the amount of surface water runoff generated by the site. As such, the development has been assessed in relation to these two potential issues.

4.1.1 Impact on Floodplain Storage

The site is located in Flood Zone 1 and is at low risk of fluvial and tidal flooding. Therefore, the proposed development is not considered to affect floodplain storage, and no provision for compensatory storage is required.

4.1.2 Impact on additional surface water runoff entering watercourses

The proposed development will decrease the amount of impermeable area on the site with the addition of landscaping for the scheme.

All Surface water runoff will be directed into the Bollin Outfall sewer which has significant redundant capacity and is circa 20 metres deep.

The Development Drainage Strategy contained will include a surface water drainage system which is capable of attenuating flows from the development up to and including the 1 in 100 year plus 40% climate change event. This drainage network will discharge flows into the MAG network and then into the Bollin Outfall Sewer.

As a result the risk of flooding in other areas as a result of the development is considered to be low and no further mitigation is required.

4.2 Impact on Surface Water

As discussed in Section 4.1.2, the impermeable area of the site will reduce.

In accordance with the requirements of the NPPF and the local planning policies discussed in Section 2.2, all increases in surface water runoff would need to be managed on site through the installation of appropriate SuDS techniques to ensure that the development does not increase the risk of surface water flooding elsewhere. As discussed, in Section 4.1.2, the development will include a below ground drainage network suitable for attenuating flows up to and including the 1 in 100 year plus climate change event. As a result, the ability of the development to increase flooding in other areas as a result of increased runoff is considered to be low and no further mitigation is required.

4.3 Impact on Groundwater

The development will involve the creation of below ground elements associated with the proposed below ground drainage network.

This element could potentially lead to a change subsurface flow regimes and a reduction in the natural storage capacity of the ground as well as and increasing the risk of groundwater flooding. However, considering the development is located within a 'Secondary B' groundwater aquifer and the groundwater catchment surrounding the site is likely to be relatively large, the volume loss due to the proposed development is likely to have a negligible impact on groundwater storage capacities or subsurface flow regimes.

Therefore, the proposed development is likely to have negligible impact on groundwater storage capacities or subsurface flow regimes.

4.4 Impact on Sewers and Water Supply Infrastructure

As previously discussed, the development will include an appropriate drainage network which will capture and attenuate all generated flows up to and including the 1 in 100 plus 40% climate change event. As such, any increase in runoff as a result of the proposed development will remain within the development boundary and will not enter an external drainage network or public sewer system.

The proposed development will generate additional foul flow which will be discharged to the existing MAG network via Pumping Station 2 prior to being pumped to the other side of the airport.. Modelling of the foul network

undertaken by Jacobs as advised by MAG indicate capacity is available in Pumping Station for the developments peak flow rate of 5 l/s.

The impact of the development on the risk of flooding from the sewer and water supply network is considered to be low and no mitigation is required.

4.5 Impact on Flooding from Reservoirs, Canals and Flood Risk Management Infrastructure

As discussed in Section 3.6, there is a commercial reservoir in close proximity to the proposed site, approximately 40m north. However, there would be no works that could affect the structural integrity of this asset. The impact of the proposed development on flooding due to reservoir failure is therefore considered to be low and no mitigation is required.

There are no canal systems within the area, therefore the impact of the development on these features is considered to be limited and no mitigation is required.

There is are no flood defences within close proximity to the proposed development site and as such, the risk of increased flooding elsewhere as a result of defence failure is considered to be low and no mitigation is required.

4.6 Land Drainage Infrastructure

There is no evidence of any land drainage infrastructure near to the proposed development and therefore the impact of the proposed development is considered to be low and no mitigation is required.

4.7 Summary of Flood Risks from the Development

Table 4-1 Summary of Key Flood Risks from the Proposed Development

Flood Risk	Summary of Risk to Development Site	Notes	Mitigation Required
Fluvial	Low	The site is located in Flood Zone 1 and surface water runoff generated by the site will be attenuated within the red line planning boundary and discharged into the Cotteril Clough Ordinary Watercourse at 5 l/s/ha. This rate has been agreed with MCC as the LLFA.	No
Surface Water	Low	As discussed above, there will be no increase in runoff from the proposed development into other areas as all flows will be attenuated by the proposed drainage network, up to and including the 1 in 100 year plus 40% climate change event.	No
Groundwater	Low	The development will include a minimal amount of below ground development, primarily associated with the new drainage system. A development of this scale is unlikely to disrupt local groundwater regimes.	No
Sewer and Water Supply Infrastructure	Low	The development will include an appropriate drainage network which will capture and attenuate all generated flows up to and including the 1 in 100 plus 40% climate change event. Whilst the development incorporates the construction of a café, the foul flow created by this will be minimal and is unlikely to increase flood risk to the surrounding area.	No
Reservoir	Low	There is a commercial reservoir in close proximity to the proposed site, approximately 40m north of the site boundary. However, there would be no works that could affect the structural integrity of this asset.	No

Flood Risk	Summary of Risk to Development Site	Notes	Mitigation Required
Canal	Low	There are no canal systems within the area, therefore the impact of the development on these features is considered to be limited and no mitigation is required.	No
Artificial Drainage Systems and Flood Risk Management Infrastructure	Low	There are no artificial drainage systems or flood risk management infrastructure within close proximity to the proposed development site and as such, the risk of increased flooding elsewhere as a result of defence failure is considered to be low and no mitigation is required.	No

5. Climate Change

5.1 Context

The NPPF requires site specific FRAs accompanying planning applications to assess the risk of all sources of flooding to and from the development and to demonstrate how these flood risks will be managed so that the development remains safe throughout its lifetime, taking climate change into account.

The EA published updated climate change guidance in February 2016¹⁶. The guidance indicates that climate change is likely to increase river flows, sea levels, rainfall intensity, waver height and wind speed.

5.2 Peak River Flow Allowances by River Basin District

The peak river flow allowances show the anticipated changes to peak flow by river basin district. The range of climate change allowances are based on percentiles. A percentile is a measure used in statistics to describe the proportion of possible scenarios that fall below an allowance level. The 50th percentile is the point at which half of the possible scenarios for peak flows fall below it and half fall above it.

- Central allowance is based on the 50th percentile;
- Higher central is based on the 70th percentile; and;
- Upper end is based on the 90th percentile.

The Proposed Development lies within the North-West River Basin District. Table 5-1 shows the climate change allowances for the North-West River Basin District.

Table 5-1 Climate Change Allowance for the North-West River Basin District

Allowance Category	Total Potential Change Anticipated for '2020s' (2015 to 2039)	Total Potential Change Anticipated for '2050s' (2040 to 2069)	Total Potential Change Anticipated for '2080s' (2070 to 2115)
Upper End	20%	35%	70%
High Central	20%	30%	35%
Central	15%	25%	30%

5.3 Peak River Flow Allowances for the Proposed Development

For Developments located in Flood Zone 1 the EA guidance for climate change allowance state

'In flood zone 1 use the central allowance for essential infrastructure, highly vulnerable and less vulnerable developments. For water compatible developments use none of the allowances.'

It is assumed that the lifetime of the Proposed Development is 100 years and based upon the EA guidance, the peak river flow climate change allowances for the lifetime of the Proposed Development should be assessed as shown in Table 5-1.

¹⁶ Environment Agency (2016) Flood risk assessments: climate change allowances [online] Available from <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>.

Table 5-2 Peak River Flow Allowances for the Proposed Project

Proposed Development	
River Basin District	North-West
Flood Zone	1
Flood Risk Vulnerability	Less Vulnerable
Lifetime of Development	100
Climate Change Allowance to be Assessed	Central Allowance (30%)

5.4 Impact of Climate Change

5.4.1 Fluvial Flooding

Given that the Proposed Development lies within Flood Zone 1 it is concluded that climate change will not significantly increase the risk of Main River flooding to the site.

As discussed in Section 1.1 two tributaries of the Cotteril Clough Ordinary Watercourses flow along the sites western and southern boundaries. There is the potential for increased flows as a result of climate change to increase the risk of fluvial flooding to the site. However, the watercourse in these locations is steeply incised relative to the proposed developed and based on discussions with the design team, the proposed developed is elevated approximately 4m above the watercourse. As such, the risk to the site from fluvial flooding is likely to be low and no further mitigation is required. However there is a residual risk of flooding to the site from Ordinary Watercourses remains.

5.4.2 Groundwater

The predicted increase in the wetness of winters and the intensity of storm events could result in the groundwater level fluctuations at the site and possibly increase the level of the water table. However, the development will be designed in such a way to be resistant to fluvial ingress and will be designed to withstand hydrostatic pressure. Therefore the risk to the development as a result of increased groundwater levels is considered to be low.

5.4.3 Sewer Flooding

It is difficult to predict precisely the impact of climate change on sewer flooding due to lack of data; however, the anticipated increase in rainfall intensity may cause greater volumes of rainfall to enter the sewer network during storm events. It is not anticipated that the risk from the sewer system, which is currently considered to be low, would increase significantly to the point that it would pose a risk to the site.

5.4.4 Surface Water Runoff Generation and Overland Flow

An increase in rainfall intensity will increase runoff rates and consequently runoff volumes. Climate change must be taken into account when considering surface water runoff generated by development sites. However, the proposed drainage system has taken into account the likely impacts of climate change, and has been designed to attenuate flows to the plus 40% climate change event.

5.5 Residual Flood Risk

5.5.1 Residual Risk from Ordinary Watercourses

As discussed in Section 3.1.2, there is a residual risk of fluvial flooding from Cotteril Clough Ordinary Watercourse and its tributaries. This risk cannot be excluded explicitly due to a lack of detailed information about the site, including modelled water levels and / or recorded flood extents.

The development itself is a fully drained logistics site which sits some 170 metres away and 7 metres highway than the watercourse therefore no further action is deemed to be required.

6. Summary and Conclusions

This FRA has been completed in accordance with the NPPF and the accompanying Technical Guidance.

6.1 Summary of Flood Risk

- A review of the NPPF and local planning policies suggests the proposed development is considered to be 'General Industry', and is classified as 'Less Vulnerable' to the effects of flooding. In accordance with Table 3, 'Less Vulnerable' developments are permitted in Flood Zone(s) 1, 2 and 3a. The proposed development is therefore considered to meet the requirements of the Sequential Test.
- The risk to the proposed development from flooding due to main rivers, surface water, ground water, canal and reservoirs, sewer and water supply infrastructure and artificial drainage systems and flood risk management infrastructure is considered to be low.
- The impact of the proposed development on flood risk from all sources, i.e. from main rivers, ordinary watercourses, surface water, groundwater, canals, reservoirs, sewer and water supply infrastructure and artificial drainage systems is considered to be low
- There is a residual risk associated with flooding from Ordinary Watercourses due to a lack of detailed modelling evidence. MAG as the site owners should ensure that adequate signage, warning systems and emergency plans are in place to ensure any risk is minimised.

6.2 Conclusion

This study has demonstrated that it will be possible to manage flood risks to and from the proposed development in compliance with the NPPF and PPG, and a strategy has been developed to control and discharge surface water runoff and foul discharge in an acceptable, conventional and sustainable manner.

Appendix A - Indicative Site Layout Plan



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Appendix B - Drainage Strategy Drawing

