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DESK STUDY: FLOOD RISK AND DRAINAGE

LAND AT HARWOOD STREET

**LITTLEBOROUGH
OL15 8NA**

Report No.: A190915-R01

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Adeptus Consulting

14 Commercial Street

Manchester

M15 4PZ

T: +44 (0)161 667 1292

F: +44 (0)161 667 1292

E: contact@adeptus.co.uk

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1 INTRODUCTION

- 1.1 The following report is a Flood Risk Assessment for the proposals at the land off of Harwood Street, Littleborough OL15 8NA, UK (see site location map below Figure 1). This assessment has been requested to accompany the planning application for the proposed residential development on the site.

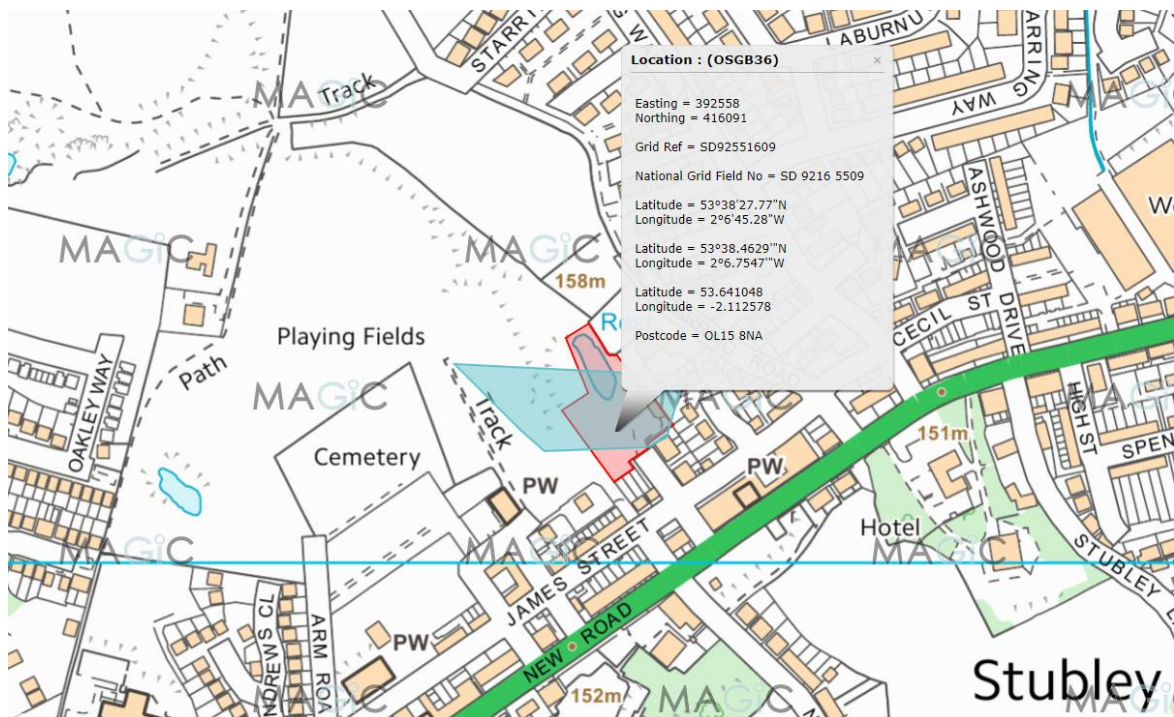


Figure 1 - Site Location Plan (site bordered red) - Source Magic Map

- 1.2 The Surface Water Drainage Strategy has been undertaken in accordance with the National Planning Policy Framework (NPPF) and its Technical Guidance, Environment Agency (EA) Standing Advice, SuDS Manual, Greater Manchester County Council (GMCC), Rochdale District Council (RDC) Strategic Flood Risk Assessment (SFRA) and the Rochdale Borough's Strategy for Flood Risk Management 2013-2023 (Consultation Draft).

DEVELOPMENT PROPOSALS

- 1.3 This assessment is based on the proposals for the demolition of the existing buildings on the site and the construction of a residential development (see Appendix 1).
- 1.4 It is understood that a development of this nature has a design life of approximately 100 years (design epoch 2119).

2 LOCAL FEATURES

- 2.1 The site is located in a largely residential area, bordered to the north and west by green open space and to the south and east residential properties. The existing site consists of a garage and large open space, with access provided from Hardwood street from southern boundary,
- 2.2 More widely, Hollingworth Lake is located approximately 1.3km to the south east, Smith Bridge Rail Station 900m to the south and St Andrews CoE 440m to the east. The River Roch is located approximately 500m to the south and flows in a east west direction.
- 2.3 The site is situated on a natural slope falling from the northern boundary at approximately +161mAOD and to the southern boundary to approximately +155mAOD. The longitudinal fall across the site is approximately 6.5%. Land to the west of the site appears to be 4-6m higher, banking down to the subject site, than banking down again to the properties on the eastern boundaries, with sectional levels being relatively flat (Source: 1m LiDAR).

RIVERS AND WATERCOURSES

- 2.4 The nearest identified watercourse to the site appears to be the Featherstall Brook located 350m to the east and runs towards the south where it joins with the River Roch approximately 500m to the south. Both the Featherstall Brook and River Roch are classified as EA Main Rivers.
- 2.5 The site is located within the North West river basin district and covers approximately 13,200km². It extends from Cumbria in the north and includes parts of Staffordshire to the south, parts of North Yorkshire in the east and Merseyside to the west. The management catchments that make up the river basin district include many interconnected rivers, lakes, groundwater and coastal waters. These catchments include, for example, lakes and rivers in the Lake District and significant sandstone aquifers used for public water abstraction. Around 80% of the river basin district is rural, with the majority of land being used for agriculture. Livestock farming is the most common rural land use, which has shaped much of the landscape. The Lake District and Lancashire coast are tourism centres and make a significant contribution to the local economy.

GEOLOGY & HYDROGEOLOGY

- 2.6 The online British Geological Survey (BGS) shows the site to be underlain by Pennine Lower Coal Measures Formation - Sandstone, with superficial deposits of the Till, Devensian - Clay, Sandy, Gravelly, Silty.
- 2.7 The Cranfield University SoilScapes online maps note the area to have impeded drainage as a result of the underlying clays, but may be slowly permeable seasonally wet. It is unlikely that the ground conditions will be suitable for infiltration SuDS, however this should be confirmed prior to detailed design.
- 2.8 The underlying hydrogeology is designated as Secondary Type A within the bedrock and Secondary (undifferentiated) within the superficial deposits.

GROUNDWATER

- 2.9 The Environment Agency's online groundwater maps do not show the site to be located within a source protection zone. Furthermore, these maps also show the underlying groundwater to be of a minor high vulnerability.
- 2.10 The EAs '*Groundwater (User Guide) Vulnerability Maps Technical Summary*', details that the residential developments in areas of deemed to be over minor aquifers are generally suitable given suitable treatment is provided (in accordance with the SuDS Manual).

EXISTING SURFACE WATER DRAINAGE

- 2.11 The site area has been measured at approximately 0.45ha (4500m²). It would appear that the site has an existing surface water drainage system, and is understood this drains to a pond located in northern portion of the site. It is unclear at this time if this pond overflows into a wider stream/ditch network (this should be confirmed prior to development to inform the surface water drainage design).

EXISTING FOUL WATER DRAINAGE

- 2.12 The existing site is containing 1 commercial unit (existing garage use). This appears to have a existing foul water connection to the public sewer in Harwood Street.
- 2.13 At the time of writing, it is unclear the scale of the proposals, but it is assumed that capacity will be available in both the surface and foul water drainage systems, and as such the development proposals would not increase flood risk into the local network (subject to capacity checks with United Utilities).

3 FLOOD RISK VULNERABILITY

- 3.1 This FRA has been undertaken with due regard to the statutory requirements of the NPPF and with reference to the Planning Practice Guidance (PPG) in relation to development and flood risk. This FRA aims to ensure that flood risk is taken into account and to avoid inappropriate development in areas potentially at risk of flooding.
- 3.2 Table 2: Flood Risk Vulnerability Classification, of the PPG provides guidance on assigning development vulnerability. Based on the proposed agricultural use, it is considered that the proposals are 'More Vulnerable'.
- 3.3 The existing site is currently a brownfield site comprising existing commercial use. The site in its present state is considered 'Less Vulnerable', post development there will be an increase in vulnerability based on the proposed residential use to 'More Vulnerable'.

SEQUENTIAL TEST/EXCEPTION TEST

- 3.4 The EA have designated different areas of the UK based on specific risk to assist and steer developments, these are:
- ⇒ Flood Zone 1 - land assessed as having a less than a 1 in 1,000 annual probability of river or sea flooding (<0.1%)
 - ⇒ Flood Zone 2 - land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% – 0.1%) in any year
 - ⇒ Flood Zone 3 - land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year. Flood Zone 3b is land have greater than 1 in 20 annual probability of flooding.
- 3.5 According to NPPF footnote 20, a site-specific FRA should be prepared when the application site is:
- Situated in Flood Zone 2 and 3; for all proposals for new development (including minor development and change of use); or
 - Greater than 1 ha in size and located in Flood Zone 1; or
 - Located in Flood Zone 1 where there are critical drainage problems or within a designated Critical Drainage Area (CDA) as notified to the LPA by the Environment Agency; or
 - At risk of flooding from other sources of flooding, such as those identified in this SFRA; or
 - Where surface water flood risk exists, detailed surface water modelling may be required; or
 - Subject to a change of use to a higher vulnerability classification which may be subject to other sources of flooding.

- 3.6 Using EA Flood Map for Planning (Figure 2 below), the site is shown to be wholly within Flood Zone 1. This demonstrates that there is a less than 1 in 1,000 annual probability of flooding from River and Sea. However according to the Rochdale SFRA, the site is located within a Surface Water Flooding Hotspot/Critical Drainage Area and such requires a site specific FRA (in accordance with the NPPF).



Figure 2 extract EA Flood Maps for Planning

- 3.7 Under the NPPF, all new planning applications must undergo a Sequential Test. This test must be implemented by local planning authorities with a view to locating particularly vulnerable new developments (e.g. residential, hospitals, mobile homes etc.) outside of the floodplain.
- 3.8 In principle, the Sequential Test has been applied as the development proposals are shown to be wholly within Flood Zone 1. Furthermore, on the basis of flood risk, an Exception Test is also not required.
- 3.9 Table 1 below presents a helpful guide in identifying the suitability of a site prior to applying the Sequential Tests in its entirety and identifies when the Exception Test is required.

Table 1 The Sequential Test: Flood Risk Vulnerability and Flood Zone 'Compatibility' Table as specified by NPPF. Shaded cells denote the proposed re-development. Please note: ✓ means development is appropriate; x means the development should not be permitted and should be subject to a full sequential test.

Flood Risk Vulnerability Classification	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	✓	Exception Test Required	✓	✓
Zone 3a	Exception Test Required	✓	x	Exception Test Required	✓
Zone 3b Functional Floodplain	Exception Test Required	✓	x	x	x

Therefore, based on Table 1 above, the development proposals are deemed suitable at this location.

- 3.10 In addition to assessing flood risk from Rivers and Seas, the EA has also undertaken national scale flood risk mapping including flooding from surface water and reservoir breach. Furthermore, each council produces a Strategic (county scale) Flood Risk Assessments (SFRA) that aim to specifically identify local flood risk issues (such as critical drainage areas and local groundwater flooding).
- 3.11 The following section reviews both the EA data as well as information available from the Greater Manchester SFRA and Rochdale SFRA at the time of writing.

4 SOURCES OF FLOOD RISK

FLUVIAL AND TIDAL

- 4.1 As detailed above in the preceding Section, the site is shown to be located wholly within Flood Zone 1. As such the risk of flooding from Fluvial and Tidal flooding is considered to be low.

Impacts of Climate Change

- 4.2 With changes in climate profiles, it is expected that flows in rivers will increase, and as such the potential risks to properties will increase with this.
- 4.3 In line with the NPPF Technical Guidance on Flood Risk *Table 1: Guidance for river catchments and climate change allowances* 2018, it recommended that an FRA considers the impacts of climate change, and in line with the NPPF for a site of 'More Vulnerable' nature it recommended that the 'Upper' climate change allowance for the North West basin should be considered based on a design epoch to 2115 of 70%.
- 4.4 The nearest point of fluvial flood risk appears to be from the River Roch 500m to the south. Based on 1m Lidar data, the site is approximately 16m higher than the River Roch. As such, it is likely, even when taking into account climate change, the site would become affected by fluvial or tidal flooding.

SURFACE WATER

- 4.5 The EA has produced national scale surface water flood risk mapping. This mapping shows 3 event scenarios for the 1 in 30 (3.3% chance of occurring in any one year) return period (high risk – Figure 3), 1 in 100 (1% chance of occurring in any one year) return period (medium risk – Figure 4) and 1 in 1000 (0.1% chance of occurring in any one year) return period (low risk – Figure 5).
- 4.6 The high risk scenario shows that the site is wholly unaffected by surface water flooding. However, overland flows do appear to be developing to the east of the site (along Oliver Close) flowing away to the south. There is noted surface water ponding in the location of the existing pond, however this is likely a result of the modelling process and would not represent an actualised flood risk from this source.

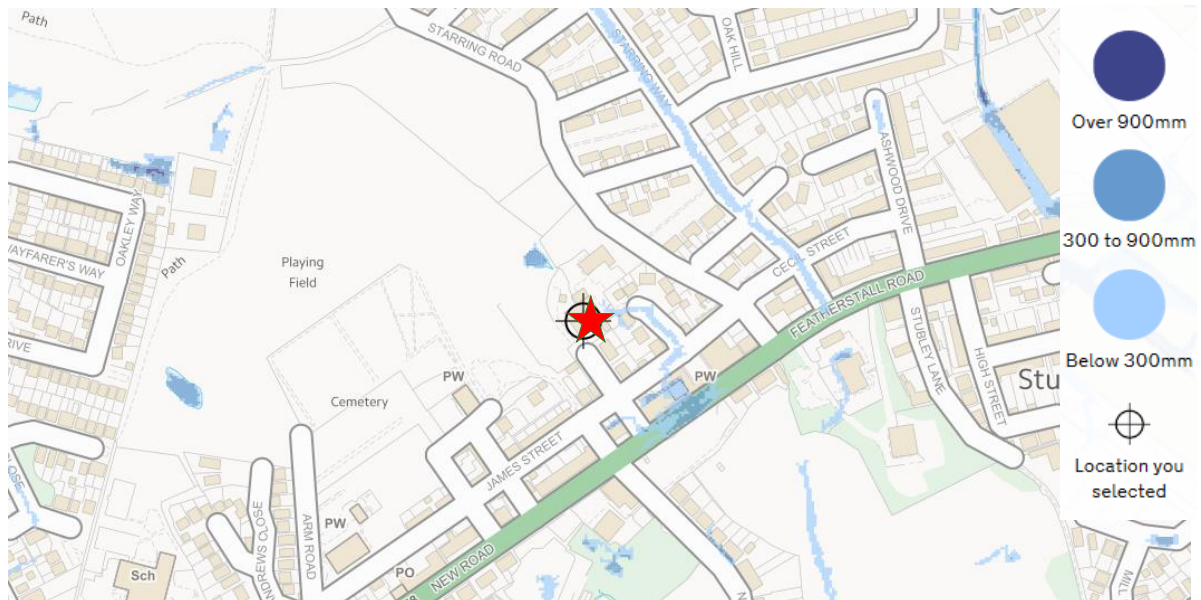


Figure 3 EA Long Term Flood Risk Maps (Extents) – High Risk of surface water flooding (source: EA Long Term Flood Risk Maps)

- 4.7 The medium risk scenario (1 in 100 year return period) shows that the majority of the site remains unaffected by surface water flooding (Figure 4). Similar to the High Risk event, overland flows appear to continue to develop and become evident along the eastern boundary, but not linking from the pond in the norther corner of the site and flowing south along Oliver Close and away from the development towards the River Roch.

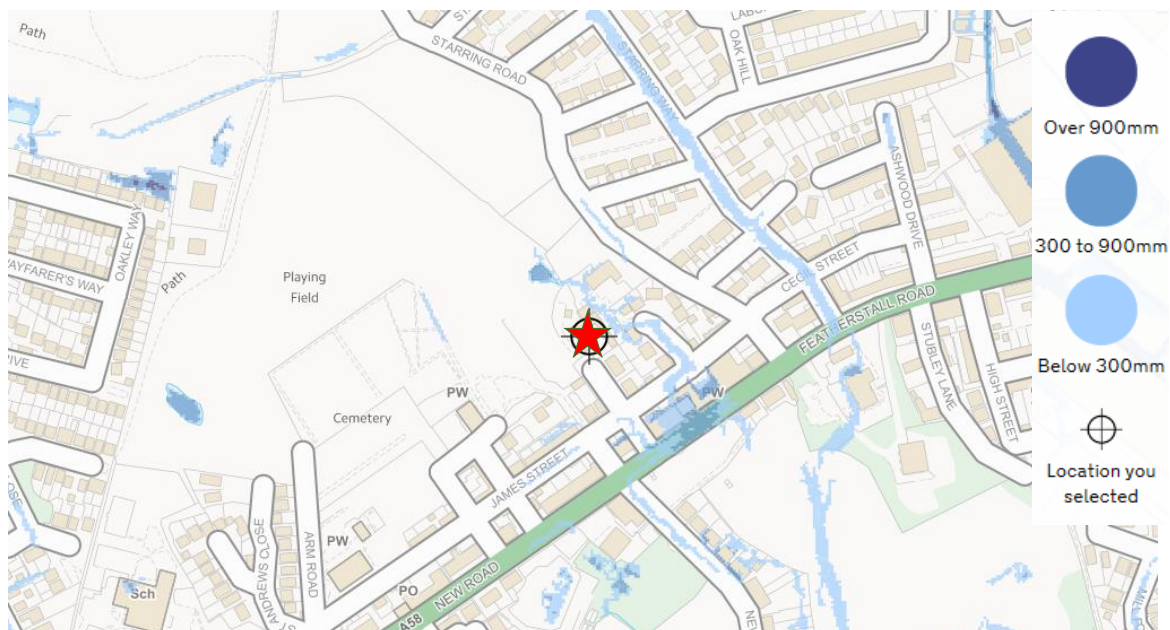


Figure 4 EA Long Term Flood Risk Maps – Medium Risk of surface water flooding (source: EA Long Term Flood Risk Maps)

- 4.8 The low risk scenario (1 in 1000 year event), shows that the site still remains largely unaffected by surface water flooding (see Figure 5). Similar to the High and Medium Risk events, overland flows can clearly be seen originating north of the site flowing south east along the eastern boundary, linking from the pond in the norther corner of the site and flowing south along Oliver Close away from the development towards the River Roch.

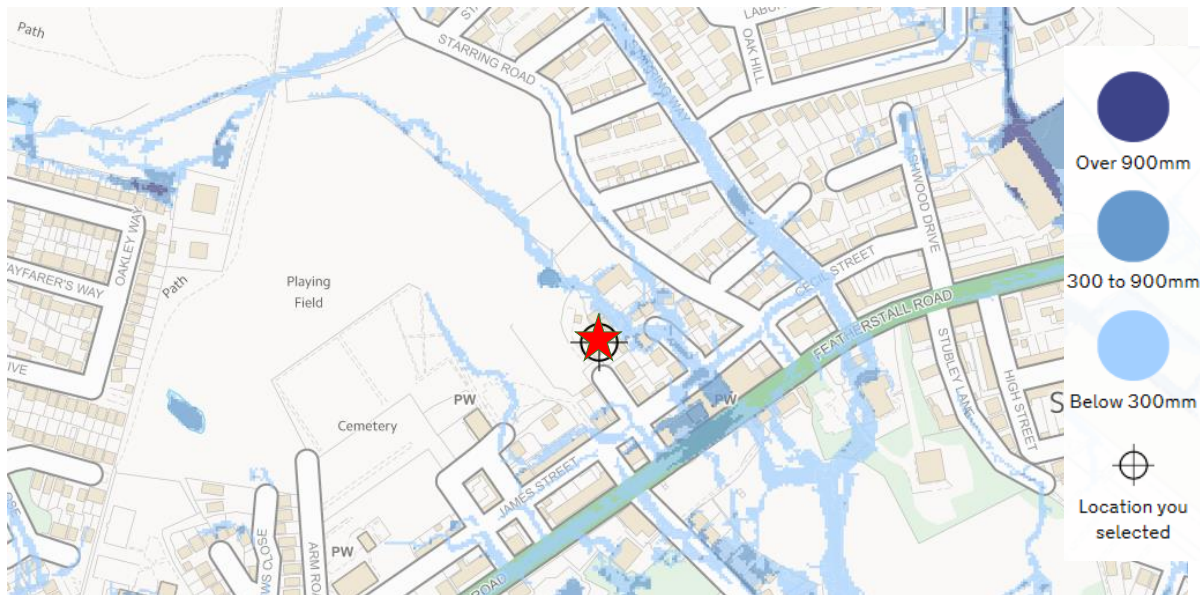


Figure 5 EA Long Term Flood Risk Maps – Low risk of surface water flooding (site red star) (source: EA Long Term Flood Risk Maps)

- 4.9 The primary risk of surface water flooding appears to be from overland flow paths generated from the wider topography, however the site does appear to remain largely unaffected by these events. All future development on the site must ensure this route remains unaffected to ensure these flow paths are not diverted or made worse as a result of the proposals.
- 4.10 Based on the above, it is considered that surface water flood risk on the site is considered low.

Impacts of Climate Change

- 4.11 With changes in climate profiles, it is expected that rainfall intensities and frequencies will increase, and as such the risk to property will increase with this. However, the risk of this is considered to be relatively low given the site located on a sloped site and directs overland flows away from the proposed development to the east. Nevertheless, it is important to ensure that the proposals do not increase flood risk as a result, incorporates flood resilient building measures and Sustainable Drainage Systems (SuDS).
- 4.12 It should be noted that the GMCC and RDC considers the implementation of SuDS as an essential element of reducing future flood risk to both the site and its surroundings. Indeed, reducing the rate of discharge from sites is one of the most effective ways of reducing and managing flood risk. SuDS can effectively be used to minimise the potential increase of risk to the property and users in the future.

RESERVOIR FLOODING (BREACH)

- 4.13 According to the EA's Long Term Flood Risk Maps for Reservoir Flooding, the site is not shown to be at risk of flooding from this source.

SEWERS AND DRAINAGE

- 4.14 A common source of flooding is a result of sewer or other drainage infrastructure becoming surcharged and flooding.
- 4.15 United Utilities is responsible for flooding from foul, surface water and combined sewers in this area. Flooding from sewers can occur when there is a blockage, collapse or their capacity to pass water is exceeded. United Utilities maintain records of properties at risk of flooding from sewerage systems and of reported incidents of flooding both internal to properties and where gardens, highways and public open spaces have flooded. Between September 2012 – September 2013 United Utilities have reacted to 19 reported hydraulic flooding incidents.
- 4.16 Data from the Rochdale Borough's Strategy for Flood Risk Management 2013-2023 (Consultation Draft) shows if an area is considered to be within a critical drainage area (or surface water flooding hotspot). This map shows that the site is within an area designated to be affected by limited/problematic drainage.
- 4.17 Therefore, assuming that appropriate capacity checks are undertaken for any offsite foul flows and runoff is managed to reflect current greenfield rates (or as agreed with United Utilities), the risk of sewer flooding to the site is considered low.

GROUNDWATER

- 4.18 Groundwater flooding is the emergence of groundwater at the ground surface or into subsurface voids arising as a result of:
- ⇒ abnormally high groundwater heads or flows;
 - ⇒ the introduction of an obstruction to groundwater flow; or
 - ⇒ the rebound of previously depressed groundwater levels.
- 4.19 Groundwater flooding usually occurs following a prolonged period of low intensity rainfall. As groundwater flow is much slower than surface flow, the flooding may not recede for long periods of time, typically weeks or even months. It is important to recognise the risk of groundwater flooding is typically highly variable and heavily dependent upon local geology, topography and weather conditions, as well as local abstraction regimes. Groundwater flooding is hard to predict and challenging to mitigate.
- 4.20 The site is not shown to be within a Source Protection Zone or an area that has a highly active aquifer. The Rochdale Borough's Strategy for Flood Risk Management 2013-2023 (Consultation Draft) presents an extract from the EAs Groundwater flood risk mapping which shows that the site is located within an area shown to be at medium to high risk of Groundwater flooding.

- 4.21 It should be noted however that there are no recorded instances of groundwater flooding at the site and given the site is situated on a slope and falling away to the south, it is considered that the risk of groundwater flooding to the site is low to moderate.

Impacts of Climate Change

- 4.22 The potential effects of climate change on groundwater levels are uncertain. Greater seasonality in groundwater level fluctuation is a potential outcome under a pattern of higher winter rainfall and less summer rainfall. Broad predictions of the impacts of climate change on groundwater levels are difficult to make at the present time.

HISTORICAL SOURCES

- 4.23 From review of the data provided in the local and regional SFRA's, there is no confirmed evidence that the site has experienced flooding directly affecting the site. Nevertheless this does not mean it is not at risk of flooding or has not flooded in the past.

RESIDUAL RISKS

- 4.24 Residual risks are those remaining after applying the sequential approach to the location of development and taking mitigating actions.
- 4.25 Given that the site is not located within an area of significant flood risk or situated behind flood defences, residual risk from such sources are considered low.

5 SUMMARY OF FLOOD RISKS

5.1 Section 4 outlines the likely sources of flooding based on the available data, the below is a summary of these risks:

- ⇒ **Fluvial** – The development proposals show that the whole site is located within Flood Zone 1, as such the risk from this source is considered **low**.
- ⇒ **Tidal** – The site is not shown to be affected from flooding from Tidal Sources.
- ⇒ **Surface Water** – There is shown some surface water flood risk in the northern corner of the site. This flood risk is shown to be from overland flow paths passing through the site. However, the area affected is a small portion of the site, with flows directed around the site to the east and south. As risk of flooding from surface water is considered **moderate** but manageable through appropriate development being focused to areas outside of this area.
- ⇒ **Reservoir** – Risk from this source is considered **low**.
- ⇒ **Sewers and Drainage** – Risk from this source is considered **low-moderate** given that the site is within a critical drainage area, however this can be managed through applying SuDS strategies and ensuring capacity is available within the local sewer network through consultation with United Utilities prior to connecting to the public sewer.
- ⇒ **Groundwater** – Risk from this source is considered **moderate to low**. **Although the site** is located in an area of medium to high risk, the site is positioned on natural sloping ground (falling from north to south), and should groundwater or emergence occur, natural ground levels would direct flood water away from the site to the south (as per existing).

Therefore, it is considered that the primary flood risk to the site is from surface water and groundwater sources. Review of the available information, flood risk from these sources are considered low to moderate, with a number of potential measures to increase flood resilience being proposed below in Section 6.

6 FLOOD MITIGATION MEASURES

- 6.1 The proposals allow the opportunity to improve flood resilience of the site by incorporating a number of flood mitigation measures, both through the incorporation of flood resilient building materials, surface water drainage improvements and signing up to the EA Flood Warning/Alert System.
- 6.2 Therefore, in order to meet the requirements of the GMCC and RDC SFRA and NPPF, it is recommended that the development proposals consider:
- Proposals incorporate SuDS, where possible, to improve surface water and overall flood management on the site. By the introduction of SuDS, site runoff can be managed more effectively both reducing onsite and downstream flood risk from surface water. It is advised that runoff rates for the proposals are restricted to existing greenfield run rates where practicable.
 - Ensure local sewer authority has been consulted (through a Pre-Development Enquiry) to ensure capacity is available to accommodate an increase in surface water or foul water flows, if these are directed to the public sewers.
 - New landscaped areas should direct runoff away from buildings where possible, with buildings being elevated at least 150mm above adjacent ground levels.
 - In the northern corner of the site, existing overland flow paths appear evident, this area should remain clear of development with ground levels to remain unchanged to ensure development proposals do not increase flood risk by displacing potential overland flows.
 - Undertake a CCTV Survey of the existing on-site drainage and undertake appropriate remediation measures.
 - Users sign up to the EA Flood Warning and Alert System and incorporate a flood evacuation plan.

BUILDING MATERIAL MITIGATIONS

- 6.3 The national government produced guidance for improving the flood resilience of building in the Communities and Local Government (CLG) 2007 'Improving the Flood Performance of New Buildings' publication. This publication provides recommendations on how to protect buildings in the case of a flood event, and propose two scenarios based on maximum expected flooded depths:

Water exclusion strategy – where emphasis is placed on minimising water entry whilst maintaining structural integrity, and on using materials and construction techniques to facilitate drying and cleaning. This strategy is favoured when low flood water depths are involved (not more than 0.3m). According to the definitions adopted in this Guidance, this strategy can be considered as a resistance measure but it is part of the aim to achieve overall building resilience

Water entry strategy – where emphasis is placed on allowing water into the building, facilitating draining and consequent drying. Standard masonry buildings are at significant risk of structural damage if there is a water level difference between outside and inside of about 0.6m or more. This strategy is therefore favoured when high flood water depths are involved (greater than 0.6m) by utilising resilient materials, and construction methods.

- 6.4 Given the primary risk is related to surface water flooding, it is considered that a **Water Exclusion Strategy** should be adopted for the proposals. Some recommendations include:
- The route of all electrical services will run from ceilings at ground floor (where possible), down toward sockets;
 - All plumbing insulation to be of closed-cell design;
 - Non-return valves to be fitted to all drain and sewer outlets;

- 6.5 Further detail can be found at <https://assets.publishing.service.gov.uk/>:

FLOOD EVACUATION PLAN

- 6.6 From the assessment above, although the site itself is deemed to be at low to moderate risk of flooding from all sources, the surrounding areas are shown to be at risk from fluvial flooding. The EA do offer a Flood Warning and Alert Service in this area and it is strongly advised site users sign up to this service, namely to ensure those leaving the site are aware of the flood risk in the immediate vicinity.
- 6.7 Further information can be found on www.environment-agency.gov.uk/floodline. It is advised that:

On receipt of a FLOOD ALERT, the individual property owners and occupiers should:

- ⇒ Monitor the situation via local media;
- ⇒ Make themselves aware of forecast local weather conditions;
- ⇒ Alert both current visitors, and those scheduled to arrive, of the situation;
- ⇒ Prepare to evacuate if necessary.

On receipt of a FLOOD WARNING, the individual property owners and occupiers should:

- ⇒ Follow advice to “go in, stay in, and tune in”;
- ⇒ Move all vehicles to an area outside of the potential flood extent, if safe to do so;
- ⇒ Alert scheduled visitors that they should seek alternative accommodation;
- ⇒ Be prepared to follow instruction from the Emergency Services.

On receipt of a SEVERE FLOOD WARNING, the individual property owners and occupiers should:

- ⇒ Follow advice to “go in, stay in, and tune in”;
- ⇒ Remain attentive to local media forecasts and news bulletins;
- ⇒ Do not evacuate unless instructed to do so by the Emergency Services;

- 6.8 Upon receipt of a Flood Warning, site users are advised to remain on site in a designated place of safe refuge such as the main house which is shown to be located wholly within Flood Zone 1. If evacuation from site is required, it is advised to travel south away from the River Test.

If flood waters along any routes leaving the site have exceeded 25cm, site users are advised to seek advice from emergency services.

7 CONCLUSION

- 7.1 This assessment is based on the proposals for the demolition of the existing buildings on the site and the construction of a residential development.
- 7.2 The existing site is currently a brownfield site comprising existing commercial use. The site in its present state is considered 'Less Vulnerable', post development there will be an increase in vulnerability based on the proposed residential use to 'More Vulnerable'.
- 7.3 The nearest identified watercourse to the site appears to be the Featherstall Brook located 350m to the east and runs towards the south where it joins with the River Roch. Both the Featherstall Brook and River Roch are classified as EA Main Rivers.
- 7.4 A review of the EA Flood Maps for Planning, Long Term Flood Risk Maps and SFRA data, indicates that the site itself is at low risk of fluvial or tidal flooding and reservoir flooding, however is at low to moderate risk of ground and surface water flooding. In addition to this
- 7.5 The EA records or SFRA show there is no historical records of flooding affecting the site.
- 7.6 A review of flood risk has been undertaken, with the primary flood risk to the site being from surface water and groundwater sources. It is recommended that the development proposals incorporate a number of simple flood resilient measures where possible to manage present and future flood risk, including:
- SuDS are incorporated, to improve surface water runoff characteristics and overall flood management on the site.
 - Ensure local sewer authority has been consulted (through a Pre-Development Enquiry) to ensure capacity is available to accommodate an increase in surface water or foul water flows, if these are directed to the public sewers.
 - New landscaped areas should direct runoff away from buildings where possible, with buildings being elevated at least 150mm above adjacent ground levels.
 - The northern portion of the site may form part of an existing overland flow paths, this area should remain clear of any development that may affect ground levels to ensure development proposals do not increase flood risk by displacing potential overland flows.
- 7.7 As such, it is considered that further betterment, in terms of flood risk, can be also be provided by incorporating:
- ⇒ Users of the site sign up to the EA Flood Warning and Alert Service and have a Flood Evacuation and Management plan in place;
 - ⇒ Sustainable Drainage Measures are put in place to reduce onsite surface water and groundwater flood risk;

-
- 7.8 This report demonstrates that the proposals can be accommodated within the site by sequentially locating development proposals to the southern areas of the site, flood risk to buildings or people can be minimised in accordance with the EA guidance, Rochdale SFRA, and the NPPF for developments of a 'More Vulnerable' nature in Flood Zones 1 and located in a Critical Drainage Area.
- 7.9 It is considered that as long as the development follows the advice presented in this report, that the development proposals can be considered appropriate at this location.

APPENDIX 1 – SUPPORTING INFORMATION

- *Architectural Proposals*
- *Sewer Records*

APPENDIX 2 - CALCULATIONS

APPENDIX 3 – DRAINAGE DRAWINGS

- *Drainage Layout*
- *Typical Drainage Details*

7.10

APPENDIX 4 – MAINTENANCE SCHEDULE