

- Whether the measures proposed to deal with these effects and risks are appropriate;
- The evidence for the local planning authority to apply (if necessary) the Sequential Test; and
- Whether the development will be safe and pass the Exception Test, if applicable.

The proposed development also supports the Greater Manchester Spatial Framework (GMCA, 2019) (which is informed by the SFRA), in particular Policy GM-S 5 for the “investment in wastewater treatment to reduce the frequency of intermittent discharges of storm sewage.

2.2.2 Rochdale Core Strategy, Adopted 2016

Rochdale Core Strategy (RBC, 2016) is a planning policy document which sets out the strategic framework and policies to guide developments within Rochdale. Policy SO4 G8 outlines the requirements for developments to follow in relation to managing water resources and flood risk. The proposed development complies with this policy; in particular, the proposed CSO improvements works would “contribute where possible to alleviate existing flood risk” and “incorporate measures to improve water quality”.

2.2.3 Preliminary Flood Risk Assessment, 2011 (updated 2017)

Rochdale Preliminary Flood Risk Assessment (PFRA) (RBC, 2011) provides a high-level overview of flood risk from various flood sources. The PFRA addendum (RBC, 2017) states that there are no significant ‘Flood Risk Areas’ as defined by the Environment Agency within Rochdale.

2.2.4 Local Flood Risk Management Strategy 2014 – 2024

Rochdale Flood Risk Management Strategy (RBC, 2014) outlines the Council’s objectives for flood risk management. The strategy provides the guiding principles, delivery plan and approach which should be taken during the planning process. The strategy also discusses UU’s investment in improving its sewerage infrastructure to reduce the risk of flooding to properties. The proposed development supports the council’s objectives, in particular, to “ensure that development and land management do not increase flood risks and contribute to...the reduction of flood risk”.

3. Assessment of Flood Risk to the Existing Site

3.1 Fluvial

Fluvial flooding occurs when a watercourse exceeds its capacity and the water breaches its banks, overflowing onto neighbouring land.

The proposed development is adjacent to the River Irk, a designated Main River, which flows from east to west across the site and eventually joins the River Irwell near Manchester Victoria railway station. 'Ordinary watercourses' include all watercourses that are not designated as 'Main Rivers', such as brooks, streams, drains, ditches, and becks. The nearest ordinary watercourse appears to originate from North Manchester Golf Club and joins the River Irk approximately 600m upstream of the site.

The EA's FMfP (Appendix A) shows the site is partly located within Flood Zone 3, an area with a high probability of flooding from rivers or the sea. This zone comprises 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. The EA risk of flooding from rivers and the sea data shows the detention tank would be situated in land at high risk (to the south of the river), whereas the proposed temporary works compound would be situated in land at medium risk of flooding (north of the river) (Figure 2). Flood Zones 2 and 3 (medium to high risk) appear to generally be confined to the river corridor immediately surrounding the proposed development, however upstream of the site the fluvial Flood Zones encroach onto residential properties and industrial buildings on the right bank around Cotton Lane and Silburn Way. The site is serviced by the EA's 'Lower River Irwell' Flood Alert Area, although only land upstream of the site is serviced by the 'River Irk at Rhodes and Middleton' Flood Warning Area (EA, 2023g & EA, 2023h).

The EA's FMfP (Appendix A) also shows that there is a flood defence approximately 200m upstream from the site, on the right bank parallel to Silburn Way. This corresponds with the EA's data showing the industrial area of land around Silburn Way to be benefitting from a reduction in risk of flooding due to defences (Figure 2). However, analysis of the EA's Asset Information Management System (AIMS) data does not provide details about what the defence is, as the only defences nearby are categorised as natural high ground (EA, 2020). From a review of freely available photography, there appear to be sections of engineered banks around the site (possibly concrete bagwork or masonry walls). Two weirs are visible on United Utilities maps (Appendix G) nearby the development site, one is approximately 15m upstream of the CSO outfall and the second is approximately 300m downstream of the CSO outfall. There do not appear to be any water storage areas nearby (Appendix A).

There are no recorded flood outlines or historic flood map records within 1km of the site (EA, 2023b & EA, 2023b); this supports the PFRA which states there have been no past flood events considered to have had 'significant harmful consequences' within the area (JBA, 2011 & RBC, 2017). The SFRA's LLFA historic flood incidents map also indicates no records of flooding from any sources within 2km of the site (JBA, 2019). An internet search also found no records of Section 19 reports for flooding incidents nearby the site (the nearest was Rochdale town centre).

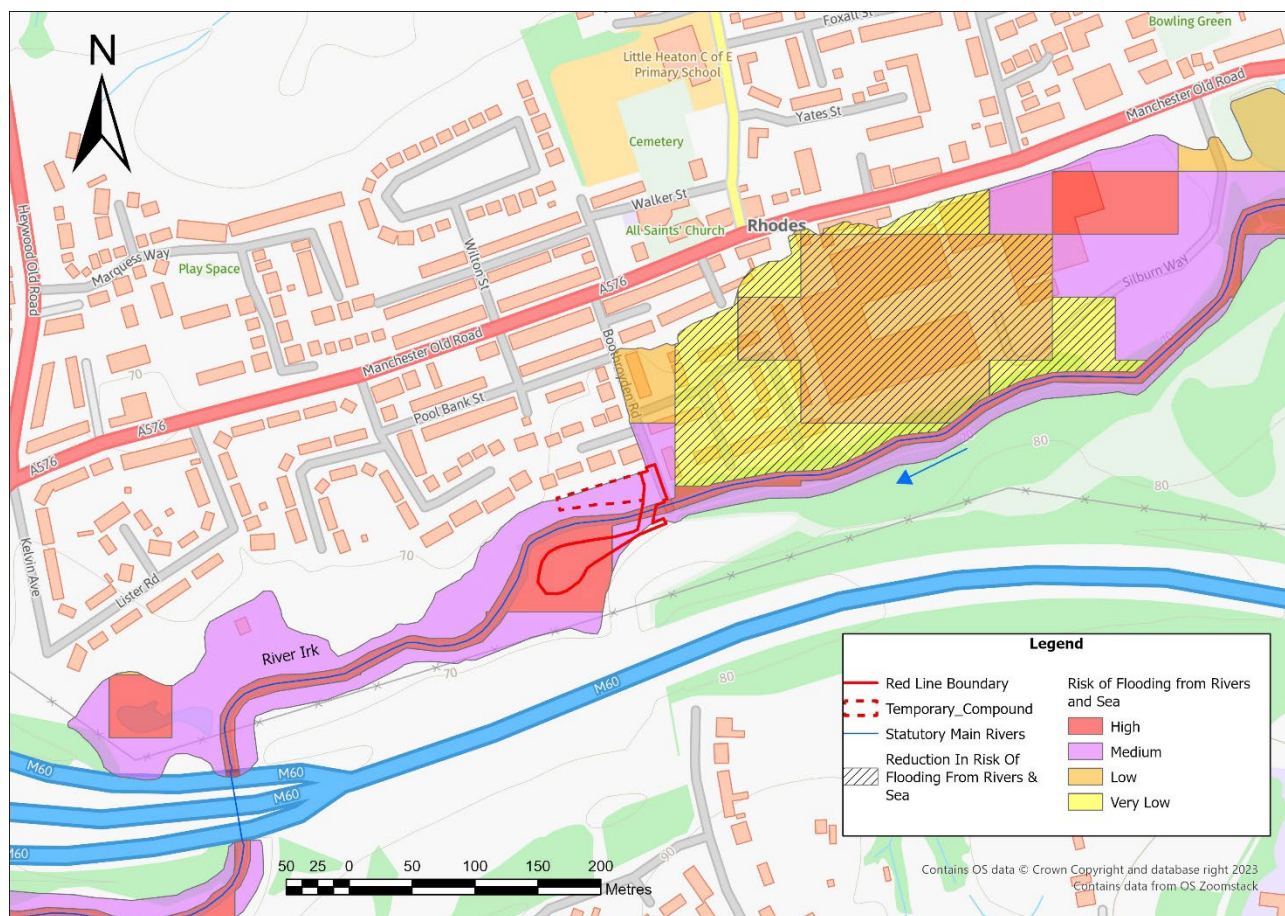


Figure 2 Fluvial flood risk surrounding the site

As part of this FRA, a data request was submitted to the EA for their Product 4 data, including hydraulic model data available. Information was received in relation to this request on 28/02/2024 and is included in Appendix H. No 2D flood levels were available but the EA did provide in-channel modelled water levels and flow measurements taken from the Irk, Moston and Whit Brook 2007 model. Data from the two closest model nodes to the development site are presented in Table 2 below. The two nodes are roughly equal distance apart (upstream and downstream) from the existing bridge, so an average has been taken between the two nodes, assuming levels and flow would be equally distributed between the nodes, to provide a slightly more accurate indication of levels and flow at the existing bridge (and adjacent proposed temporary access bridge and works area). It should be noted that it is not clear if the western (downstream) node is on the upstream or downstream side of the weir that appears to be at the same location. For the purposes of this assessment, it has been assumed to be on the upstream side of the weir.

The defended scenario, where existing flood defences are taken into account within the model, presents higher in-channel water levels and flows compared to the undefended scenario (where no flood defences are taken into account). No climate change allowance has been provided within the defended scenarios. For the defended 0.1% AEP flood event, the peak water level is 70.55mAOD upstream of the site and 68.07mAOD downstream, whilst the in-channel flow is 98.25m³/s upstream and 97.45m³/s downstream.

Based on a comparison between the peak water levels (Table 2) and the topographic survey (Appendix F), the lowest levels around the proposed development site are approximately 68.05mAOD (around the site boundary on the south bank), which means this area may experience flood depths of up to 0.83m during a 1% AEP event (based on an estimated 69.31 level at the site).

On the north bank, the temporary compound area appears to be a minimum of 68.77mAOD, so could experience up to 0.11mm of flooding during a 1% AEP event in a discrete low spot; most of the temporary compound area is above the 68.88mAOD peak flood level for the middle node so not expected to flood during a 1% AEP event. The temporary compound is expected to be in place for up to 11 months so comparison with the 1% AEP flood event level is considered conservative given low probability of such an event during the construction period.

No model information is available about water levels in events more frequent than a 1% AEP. Based on the EA's Risk of Flooding from Rivers and Sea data (Figure 2), the north bank where the temporary compound is located is at medium risk of flooding, so could flood during events with probabilities between 1 % – 0.1 % AEP. The western half of the red line boundary area (on the south bank) is at high risk, so could flood during events with probabilities >1% AEP.

Table 2 Modelled water level and flow upstream and downstream of the development site

Node	Measurement	Undefended		Defended	
		1 % AEP	1 % AEP + 20% climate change allowance	0.1% AEP	1% AEP
Upstream (No.3)	Water level (mAOD)	69.89	70.11	70.55	69.97
	Flow (m ³ /s)	53.50	60.90	98.25	55.69
*Middle (existing bridge location)	Water level (mAOD)	68.83	68.97	69.31	68.88
	Flow (m ³ /s)	53.45	60.70	97.87	55.64
Downstream (No.4)	Water level (mAOD)	67.76	67.82	68.07	67.78
	Flow (m ³ /s)	53.40	60.50	97.48	55.58

**Value estimated from an average of upstream and downstream node values*

The existing footbridge at the upstream end of the development site boundary provides pedestrian access across the River Irk from Boothroyden Road to the open space south of the river. The existing footbridge is not part of the proposed development (i.e. no changes or alterations are proposed) but the soffit level is relevant to assess as the bridge could potentially impact flows and is in proximity to (just upstream of) the proposed temporary bridge. According to topographic survey data (Appendix F), the existing bridge has a soffit level of 68.63mAOD. The existing bridge is therefore below the peak water level for the middle node for all scenarios/return periods (Table 2) so would be surcharged. The deck level on the upstream side of the bridge is 69.93mAOD (higher than the peak water level for the middle node for all return periods) so the bridge would not be expected to overtop.

The risk of flooding to the site from fluvial sources is considered **high**.

3.2 Surface Water

Surface water flooding refers to surface water runoff (pluvial flooding), usually a result of short-duration intense rainfall events where the water cannot infiltrate into the ground quick enough. This is more common in urban areas where there are more impermeable surfaces and when the urban drainage network cannot cope with the intensity of the rainfall runoff.

Surface water risk in Rochdale is often closely aligned with fluvial flood risk from rivers or topographical depressions where ponding can occur (RBC, 2016). The EA's surface water flood map (Figure 3) indicates that the proposed development site is partly within the 3.33% AEP surface water flood extent (on the north bank along Boothroyden Road) so is considered to be at high risk of surface water flooding. Here, flood depths of up to 0.60m and velocities up to 0.50m/s could be experienced during a 3.33% AEP event (EA, 2015). Similarly, during a 1% AEP event, the same area could experience flood depths of up to 0.60m and velocities up to 0.50m/s.

On the south bank, the site is partly within the 0.1% AEP surface water event and is therefore considered to be at low risk. On the south bank, EA data suggests depths of up to 0.30m could be experienced within the site boundary during a 0.1% AEP surface water flood event, whereas depths could reach 0.60m on the north bank (on Boothroyden Road) (EA, 2015). Velocities of up to 0.50m/s are expected on the south bank during this event, whereas velocities up to 1.00m/s could be experienced on the north bank.

Surrounding the site, the surface water extent follows the route of the River Irk and also encroaches onto Boothroyden Road and residential properties to the north of the site, as well as Silburn Way and industrial buildings to the east of the site. Boothroyden Road, immediately adjacent to the site on the north bank, is within the 3.33% AEP flood extent and is therefore considered to be at high risk of surface water flooding. There appears to be a surface water overland flow route originating north of West Green, which flows south via residential properties, down Wilson Street, across A576 Manchester Old Road, down Blackley Street, west across Pool Bank Street, where the flow routes splits, with some surface water flowing via residential properties off Boothroyden Road and into the River Irk, whilst other surface water flows down Boothroyden Road towards the bridge across the river, where it flows into the River Irk.

The risk of flooding to the site from surface water is considered **high**.

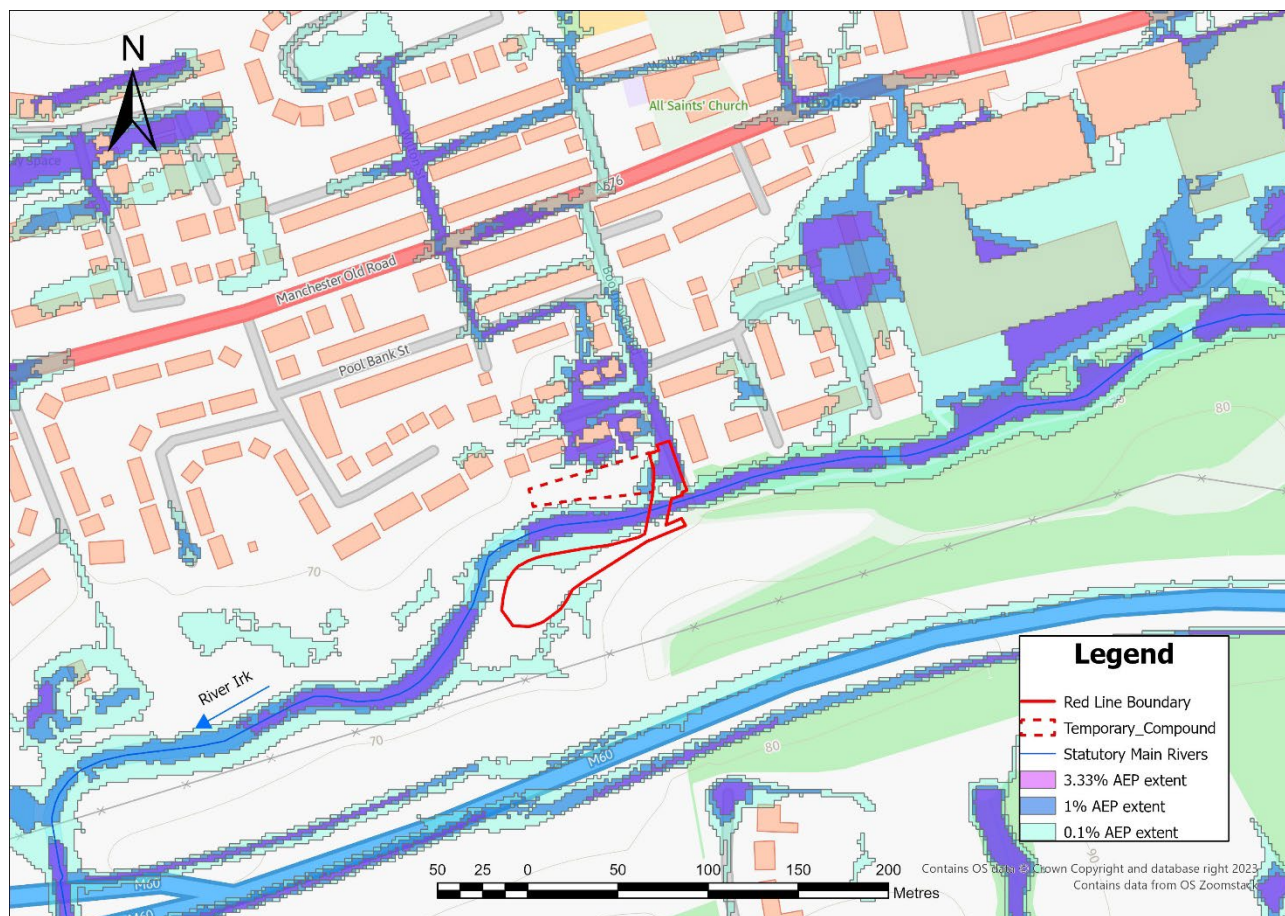


Figure 3 Risk of flooding from surface water at the site

3.3 Sewer

Sewer flooding usually occurs when the flow of water (usually rainfall runoff) entering the sewer system exceeds the discharge capacity of the system. This can be a result of a blockage in the sewer system or when surface water sewers are unable to discharge due to high water levels in the receiving watercourse. Water then surcharges the sewer network emerging at ground levels through manholes and gullies. Flood water containing foul sewage presents a significant health hazard.

Across Manchester, localised sewer flood risk is associated with aging drainage infrastructure which cannot cope with the capacity requirements of today, as well as the presence of blockages within the network (JBA 2019 & RBC, 2016). The SFRA identifies Rochdale as being within an 'opportunity area for further critical drainage management' (JBA, 2019). The SFRA's UU historic sewer flooding incidents and hotspots map indicates one sewer flooding incident to the south of the M60 near the site (date unknown). The map also shows 'hotspots', where modelled flood hazard, and local critical and vulnerable receptors have been identified, within 2km to the east of the site towards Chadderton.

UU infrastructure maps (Appendix G) display the location of the existing CSO on the south bank at the site, where the CSO outfalls on the south bank approximately 20m downstream of a weir. The map also shows combined sewer pipes flowing underground from east to west towards the CSO site; there does not appear to be connectivity to the site from the sewer system north of the river. There are also some abandoned sewers located within the site boundary on the south bank, along with clean water pipes along Boothroyden Road on the north bank.

The risk of flooding to the site from sewers would usually be low, as a build-up of sewerage in the system would discharge into the River Irk. However, if river levels were also high and the CSO outfall could not discharge (due to being river locked), the risk of sewer flooding could become **medium**.

3.4 Groundwater

Groundwater flooding occurs when water emerges from beneath the ground when the water table rises above ground level. This type of flooding usually has a slower onset compared to fluvial and pluvial flooding so the risk to life is lower, but groundwater flooding can be much longer lasting. There are several factors which can increase the likelihood of groundwater flooding including the local geology, prolonged rainfall, artificial structures, or high in-channel river levels.

The British Geological Survey (BGS) mapping identifies the site bedrock geology as Pennine Lower Coal Measures Formation of mudstone, siltstone and sandstone (BGS GeoIndex). Superficial deposits along the route of the watercourse are made up of alluvium – clay, silt, sand, and gravel. Along both riverbanks at the site, glaciofluvial sheet deposits made of sand and gravel are present (BGS Geology Viewer). The site has freely draining soils to the north of the river and slowly permeable seasonally wet soils with impeded drainage to the south (Defra Magic Maps).

The alluvium underlying the site is classified as a Secondary A aquifer typically with intergranular flow with varying permeability. The extent and thickness of these deposits limit the available groundwater yield contained within the more productive sand and gravel horizons. The unit may contain multiple perched water tables if discontinuous clay/peat lenses are present.

A review of groundwater data shows that the groundwater level varies between 0.8 and 7.8m below surface level, however the most recent data collected suggests that the groundwater level is currently 0.8 - 2 mbgl.

Geosmart (2024) groundwater flood risk mapping obtained for this study classifies the entire site and the majority of the area around it as at negligible risk of groundwater flooding. To the west of the wider study area there is a small area of both low and moderate risk. This area of increased flood risk correlates with a change in bedrock geology to the Chester Formation.

However, due to the proximity of the site to the River Irk and the relatively shallow groundwater at the site, flooding may be possible during intense, long-duration rainfall events, when river levels are high and the ground becomes saturated.

Furthermore, many issues, drain and sinks are present in the wider area, which are likely fed by perched water units in the alluvium and glaciofluvial sheet deposits. Historical mapping (1892-1914) show that the drains and issues to the east of the site used to be a spring before it was built over. These features may contribute to surface water or fluvial flooding risk during intense or long duration and recharge events.

However, based on the risk mapping for the area, the overall risk of flooding to the site from groundwater is considered **low** although it is likely that groundwater will be encountered during shallow excavation at the site which may need to be controlled and managed.

Groundwater also has the potential to impact any drainage or sewage infrastructure if ingress occurs through cracks, joints or defects in the infrastructure which may reduce efficiency and storage potential at periods of high groundwater levels.

3.5 Reservoirs

Reservoirs are defined as artificial structures used to store water, including for water supply purposes, recreation, or flood storage. Similar to the risk of flooding from canals, flood risk associated with reservoirs is residual and usually occurs as a result of a breach of the embankments or outfall. Reservoir flooding can pose a danger to life due to the sudden onset and large volumes of water that can travel at high velocity. However, all large, raised reservoirs (currently defined as those with a capacity of 25,000m³ and above), fall under the

Reservoirs Act 1975 and as such are regularly inspected and supervised by panel engineers. Therefore, the risk of reservoir failure is generally low.

The site appears to be at risk of flooding from an uncontrolled release of water from reservoirs (Figure 4). The reservoir flood extent generally follows the route of the River Irk and associated fluvial flood extent, although the reservoir extents, for both a 'dry day' and 'wet day' (when river levels are also high), are smaller than the Flood Zone 3 extent. According to the EA's long term flood risk map, the reservoir risk at the site is associated with 'Rhodes Lodge – Big Pond', approximately 600m upstream, which is owned by Rochdale Borough Council.

The risk of flooding to the site from reservoirs is considered **low**.

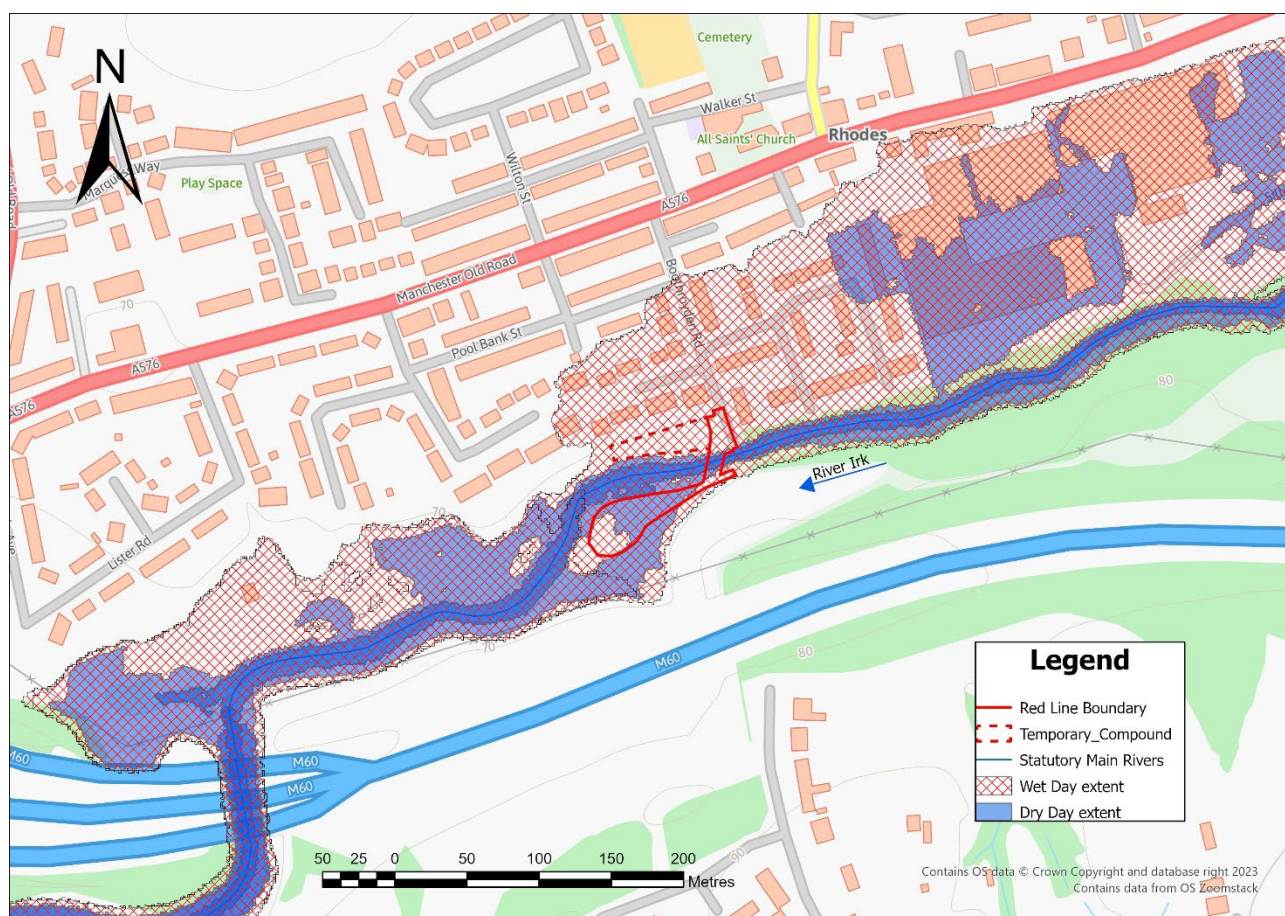


Figure 4 Risk of flooding from reservoirs at the site

3.6 Other (tidal, canals)

There are no canals nearby the site; the closest is Rochdale canal, approximately 3.9km away. The Rochdale canal is a controlled waterbody and as such the overtopping risk is low (JBA, 2019). The development is therefore considered to be at very low risk of flooding from canals.

Similarly, the development site is not at risk of tidal flooding based on its elevation and distance from the coast.

The risk of flooding to the site from other (tidal or canal) sources is considered **low**.

3.7 Summary of Flood Risk to the Site

The primary source of flood risk to the site is from the River Irk (fluvial), which flows from east to west through the site. According to the Environment Agency FMfP, the site is largely within Flood Zone 3 and at high risk of flooding from fluvial sources. Comparison of the 1% AEP peak flood levels with a topographic survey shows flood depths of up to 0.83m would be expected within low spots on site during this event on the south bank. However, much of the proposed work area on the south bank is above the 1% AEP flood level, suggesting it is largely outside of the floodplain. No flooding would be expected on the north bank during the 0.1% AEP event. The site is also partly at high risk of surface water flooding, with the north bank within the 3.33% AEP surface water flood extent (high risk). Depths of up to 0.60m and velocities up to 0.50m/s could be experienced during a 1% AEP surface water flood event on the north bank within the site boundary. The site on the right bank is at low risk of surface water flooding so would not be expected to flood during a 1% AEP surface water event. The site is located at the existing Boothroyden Road CSO and as such there is combined sewer infrastructure underground within the site boundary, so sewer flooding is possible. Based on publicly available data, groundwater flooding is unlikely in the general area, although due to the proximity of the site to the River Irk, groundwater flooding may be possible during intense, prolonged rainfall events, when river levels are high, and the ground becomes saturated. Additionally, the site is at risk of flooding from an uncontrolled release of water from a reservoir upstream of the site, however this risk is considered very low. Other sources (including tidal and canals) have been assessed and the risk is considered very low due to the site's elevation and distance from those sources.

4. Assessment of Flood Risk as a Result of the Proposed Development

4.1 Fluvial

The proposed detention tank would be a minimum of 9.5m away from the riverbank, providing a sufficient buffer for access and maintenance of the banks and channel, and minimising the risk of impacting the structural integrity of the banks. The tank would be underground so would not be expected to negatively impact fluvial flood risk. The operation of the proposed detention tank would reduce the frequency of overflow spills from the CSO into the River Irk, potentially having a positive impact on the river's capacity and surrounding flood risk, although the impact of reduced overflow spills would likely only be notable in low magnitude fluvial flood events.

Situated above the tank, the proposed kiosk and pressure relief column would be above ground. Comparison of the topographic survey with the flood levels for the land where the kiosk and pressure relief column are proposed, suggests this section of land sits at a minimum of 68.21mAOD, which is 0.67m below the 1% AEP peak flood level of 68.88mAOD (middle node in Table 2), so within Flood Zone 3. The tank lid and kiosk would be watertight, and the pressure relief column raised above predicted flood levels to avoid any floodwater from entering the structures. If floodwater entered the tank, it would fill up earlier than expected and reduce the existing sewer network capacity. If floodwater were to enter the pressure relief column, it would compromise the venting process of the tank and its pressure. It is recommended that the kiosk ventilation louvre is built no lower than 69.18mAOD, to provide a 300mm freeboard above the 1% AEP flood level; this will help prevent the kiosk from flooding via the ventilation louvre. If floodwater were to enter the kiosk, it would compromise the control panel, telemetry and electric instruments, and therefore the function of the existing CSO and proposed tank. Over the 50-year design life of the proposed development, climate change may increase the frequency and intensity of flood events so the area could flood in lower magnitude events, more regularly restricting access to the proposed development during heavy rainfall events. However, the site will be operated automatically and only need to be accessed for maintenance, so access should not be required during flood events.

The total volume of space taken up by the kiosk and pressure relief column within the floodplain is approximately 4m³, calculated using a height of 0.67m (the 1% AEP flood depth) x width x length of the structures as per Appendix D. This area is assumed to be outside of Flood Zone 3b (functional floodplain) due to being back from the riverbank and the volume is likely to have very minimal impact on floodplain capacity, so any minor increase in risk would impact the immediate surrounding open space rather than properties or infrastructure, and therefore would not increase flood risk elsewhere.

The proposed temporary bridge (and eastern end of the temporarily raised access track leading to the bridge), would be located within 8m of the channel, as the bridge would cross the River Irk. It is assumed that construction would be carried out in an appropriate way to minimise any risk of affecting the structural integrity of the riverbank and access to the adjacent riverbank would be maintained during construction. The proposed temporary compound would be a minimum 8m away from the riverbank.

The proposed temporary bridge soffit would be built no lower than 68.63mAOD. Although this level is below the 68.88mAOD peak flood level for the 1% AEP event (middle node in Table 2), it means the proposed bridge would be built no lower than the existing bridge just upstream, so would be anticipated to have a negligible impact on flows. During a 1% AEP event, the proposed bridge would likely be surcharged although assuming the deck level is no lower than the adjacent existing bridge, the proposed temporary bridge would not be expected to overtop during a 1% AEP event. However, it is assumed works would cease in such flood conditions so access to the site (including use of the temporary bridge) would not be necessary. As the proposed bridge would be a temporary structure only present during the construction period (11 months), it is not considered appropriate to assess the impact of climate change. Comparison to the 1% AEP peak flood level is considered conservative but no lower magnitude return period flood data is available.

The proposed temporary bridge abutments would be located within Flood Zone 3 so there could be a temporary reduction in floodplain storage capacity during the 11-month construction period. Based on data available (Table 2) it is not possible to prove whether the proposed development falls within Flood Zone 3b or not (functional floodplain). However, based on the EA's Risk of Flooding from Rivers and Sea data (Figure 2), the abutments would be located in land at medium risk of flooding, which has between a 1 % – 0.1 % AEP of river flooding and is therefore likely outside of Flood Zone 3b. Furthermore, topographic data suggests the road levels, above which material will be infilled to the temporary bridge level, are approximately 69.3mAOD, which is above the 1% AEP flood level of 68.88mAOD (middle node Table 2). Calculations have been undertaken based on the following design assumptions for the two abutments and temporary ground level raising around both ends of the proposed bridge: 6.5m width x 4.5 length x 0.5 depth. These suggest approximately 29m³ of reduced floodplain storage during construction. Considering the small volume and given that the abutments are likely outside of Flood Zone 3b, the impact of this is likely to be localised and very small and could result in increased flood risk to the adjacent open space land during the 1% AEP event; no increase in flood risk to properties or infrastructure is expected from this, so temporary floodplain storage compensation is not considered proportionate.

Where ground levels are proposed to be raised by 150mm to accommodate the compound, the land is above the 68.88mAOD 1% AEP peak flood level (compared to the middle node in Table 2) so would not be expected to flood during this return period, apart from a discrete low spot on the boundary. The compound is therefore not expected to have an impact on fluvial flood risk to the site or elsewhere.

The current levels along the access track are a minimum of 68.38mAOD, so if levels were temporarily raised by 150mm to a minimum of 68.53mAOD (as per the current design), the access track could experience flood depths of 0.35m during a 1% AEP event and 0.78m during a 0.1% AEP event (compared to the middle node in Table 2). Approximately half of the access track (the eastern end) is currently above the 1% AEP peak flood level (without ground raising). An estimate of floodplain loss has been undertaken based on the following design assumptions for the ground level raising along the section of access track within the 1% AEP flood extent: 30m length x 3m width x 0.15m depth. This suggests a maximum 13.5m³ of reduced floodplain storage during construction. This temporary loss of floodplain storage capacity could increase flood risk to the site and adjacent open space land during the 1% AEP event, but would not be expected to impact residential properties or infrastructure further away and at higher levels.

Vegetation clearance, including tree removal, as part of the enabling works to gain access to the working area, could reduce the stability of the riverbanks and increase the rate of erosion. It is assumed that the vegetation clearance would be carried out under supervision of a suitably qualified ecologist and in a carefully controlled manner to minimise any impact on the riverbanks. Further recommendations to minimise residual risks are discussed further in Section 5.

The existing risk of flooding from fluvial sources to the site during construction is **high**. The proposed temporary and permanent works are expected to have minimal impact on fluvial flood risk on the site or elsewhere. The risk to the proposed development during operation will therefore also remain **high**, although this is not expected to impact the operation of the site as it would be water-compatible. Recommendations to mitigate the residual risk are discussed in Section 5.

4.2 Surface Water

The site is at high risk of surface water flooding on the north bank, where the temporary compound and north abutment to the temporary bridge would be accessed from off Boothroyden Road. Elsewhere, the site is at low risk of surface water flooding. There is the potential for the proposed vegetation clearance, temporary compound, temporary bridge, access track, kiosk and pressure relief column to increase the impermeable surface area within the site. The temporary access track would cover an area of approximately 241m², although the track already exists but is being raised and slightly widened during construction, so some of this area is likely already impermeable. The temporary compound would temporarily increase the impermeable area by approximately 774m². This would increase surface water runoff and therefore could increase the risk

of surface water flooding on site without mitigation. Assuming works are carried out appropriately, including temporary drainage incorporated into the detailed design of the temporary works and implemented during construction, it is unlikely that there would be any increase in surface water flood risk. The kiosk and pressure relief column would increase the impermeable surface area on site by approximately 4.5m², so would likely have minimal impact on surface water flood risk to the site or elsewhere.

Raising of ground levels to accommodate for the proposed temporary compound and access track could interfere with overland flow routes and increase surrounding flood risk. As surface water flows from north to south towards the proposed compound, if the compound is raised, surface water may pond more at the properties to the north of the compound off Boothroyden Road if left unmitigated, however this risk will be avoided through the implementation of temporary drainage (as discussed in Section 5). Impacts of ground raising on the proposed access track are likely to be minimal as this area is currently at very low risk, the ground raising would be relatively shallow (150mm) and the track is not currently within an overflow flow route. The track already leads towards the River Irk so any overland flow during construction would be directed towards the river, and there are no properties nearby the track so this would not be expected to increase flood risk elsewhere.

No changes to surface water drainage, such as implementation of Sustainable Drainage Systems (SuDS), are proposed. It is expected that the runoff from the site, including the proposed bridge, will continue to naturally discharge into the River Irk.

Climate change is likely to increase the frequency and intensity of flash flooding events, so where the proposed permanent works are currently at low risk of surface water flooding, this area could become at a greater risk over the 50-year design life of the development, meaning higher flood depths and velocities would be experienced. However, the site will be operated automatically and only need to be accessed for maintenance, so access should not be required during flood events. Further recommendations to minimise the residual risk of surface water flooding are discussed further in Section 5.

The existing risk of flooding from surface water to the site during construction is **high** on the north bank, although most of the site is at low risk. The proposed temporary works could increase surface water risk, although this is expected to be avoided through the implementation of temporary drainage and so is not expected to impact risk elsewhere. The proposed permanent works are expected to have minimal impact on surface water risk and therefore the risk of flooding from surface water as a result of the proposed development is likely to remain **high**, although this is not expected to impact the operation of the site as it would be water-compatible. Recommendations to mitigate the residual risk are discussed in Section 5.

4.3 Sewer

The proposed development involves construction of an underground storm water detention tank with a capacity of 2,000m³ to increase the sewer network capacity. The risk of sewer flooding to properties and infrastructure is therefore expected to decrease as a result of the scheme.

The works will be carried out in proximity to existing sewer infrastructure, including combined sewers, and as such it is expected that safe systems of work will be in place, particularly for excavation works, to ensure the existing sewer infrastructure is not damaged.

The existing risk of flooding from sewers to the site during construction would generally be low, but could become **medium** if river levels were high so the CSO could not discharge and become overwhelmed. The proposed temporary works are not expected to impact the risk of sewer flooding on site or elsewhere. The permanent works would decrease the risk of flooding from sewers elsewhere. However, the risk to the site would likely remain **medium** due to the residual risk of the CSO becoming river locked and not being able to discharge, although this is unlikely and would not impact the operation of the site as it is water-compatible.

4.4 Groundwater

Groundwater risk mapping suggests that groundwater flooding is unlikely within the site but could be possible during intense, long-duration rainfall events when river levels are also high. The proposed detention tank will be below ground level so is the structure most likely to be at risk from the shallow groundwater levels recorded at the site. The risk of groundwater flooding during construction of the proposed tank is expected to be addressed by de-watering. It is understood that the tank would be designed to resist flotation when empty and with a groundwater level coincident with ground level or at the identified flood level for the site, whichever is highest. Any groundwater flooding to the site would likely drain back into the River Irk rather than towards receptors.

Checks have also been undertaken during the design to ensure the temporary stability of the shaft against flotation during construction. Construction works are proposed to commence in Autumn 2024 and would take approximately 11 months, so would include works over winter (generally wetter months). Further recommendations to minimise the residual risk of groundwater flooding are discussed further in Section 5.

It should be noted that shallow groundwater has the potential to impact any drainage or sewage infrastructure if ingress occurs through cracks, joints or defects in the infrastructure which may reduce the efficiency or and storage capacity at periods of high groundwater levels. It is assumed infrastructure will be design to be resilient to this risk of ingress.

The existing risk of flooding from groundwater to the site is **low**. To mitigate the risk of groundwater ingress during excavation for the proposed tank, de-watering will likely be required. The proposed development is not expected to impact the risk of flooding from groundwater on site or elsewhere, so the risk is likely to remain **low**.

4.5 Reservoirs

The nearest reservoir is approximately 600m to the east of the site, so the proposed works are not expected to damage the reservoir or increase the risk of an uncontrolled release of water from reservoirs. However, the extent of flooding from reservoirs at the site is linked to the fluvial flood extent, as an uncontrolled release of water is expected to flow towards the site via the River Irk. The proposed permanent works are not expected to increase fluvial flood risk and so the reservoir flood risk extent is also not expected to change on site as a result of the development. The temporary ground level raising for the access track, bridge abutments and compound may temporarily reduce the floodplain storage capacity, which could temporarily increase fluvial flood risk to the immediate surrounding area (Section 4.1). This means on a wet day (when river levels are also high) the reservoir flood extent, depths and velocities could be greater, although it is highly unlikely there would be a breach in a reservoir during the 11-month construction period. The volume of floodplain lost is also very small and therefore unlikely to make a significant difference in the context of a significant reservoir breach.

The existing risk of flooding from reservoirs to the site is **low**. The proposed development is not expected to impact the impact the risk of flooding from reservoirs on site or elsewhere, so the risk is likely to remain **low**.

4.6 Other (tidal, canals)

The site is not currently at risk of flooding from the tide or canals due to the distance from these flood sources. The proposed development is not expected to have an impact on tidal or canal flood risk to the site or elsewhere.

The existing risk of flooding from other (tidal and canal) sources is low. The proposed development is not expected to impact the risk of flooding from other (tidal and canal) sources on site or elsewhere, so the risk is likely to remain **low**.