City of Wolverhampton Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables

Site details	
Site Code	**E6**
Address	Mammoth Drive, Wolverhampton Science Park
Area	0.83ha
Current land use	Brownfield with greenery
Proposed land use	Employment
Flood Risk Vulnerability	Less Vulnerable
Sources of flood risk	
Location of the site within the catchment	The site is bounded by Mammoth Drive along the north-western boundary and Coxwell Avenue to the south-western boundary. At the eastern boundary there is a rail track upon an arched bridge. The site has industrial estates to the east and north-west of the site, and the Birmingham Canal to the south-western of the site. The site is located within urbanised upstream reach of the Smestow Brook catchment, which is culverted at the site along the south-western boundary, there is also a culvert that flows along the north-western boundary that has a confluence with the Smestow Brook at the western corner of the site. The site is unlikely to drain into culverted watercourses or the Birmingham Canal.
Topography	Environment Agency 1m resolution LiDAR across the site shows that the site is on a western slope, with an area of high ground at the southern corner of the site. The highest point of elevation is 121.9m AOD within the high ground, and the lowest elevation is 118.2m AOD at the western corner of the site. The site is situated within a densely populated, developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in this assessment.
Existing drainage features	There are no drainage features within the site and due to the topography, the site is unlikely to drain into the Birmingham Canal. However, the site is likely to drain into the surface water sewer network where there are urban extents, which is in turn likely to then drain into the River Tame.
Critical Drainage Area	The site is not located within a Critical Drainage Area (CDA).
Fluvial	**The proportion of site at risk FMFP:** **FZ3 – 0%** **FZ2 – 0%** **FZ1 – 100%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For example:*

	Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%). **Available data:** Flood Zones are determined from the Environment Agency's Flood Map for Planning (FMfP). **Flood characteristics:** The site is situated entirely within Flood Zone 1 and is highly unlikely to encounter fluvial flood at the site.
Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 1.09% Max depth – 0.3 – 0.6m Max velocity – <0.25m/s **1% AEP** – 2.75% Max depth – 0.3 – 0.6m Max velocity – 0.25 -0.5m/s **0.1% AEP** – 32.48% Max depth – 0.3 – 0.6m Max velocity – 1.0 – 2.0m/s *The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %).* **Available data:** The Environment Agency's Risk of Flooding from Surface Water mapping was used in this assessment. **Description of surface water flow paths:** The site is predominantly affected by the 0.1% AEP event. In the 3.3% AEP event, there is a small area of ponding at the upper south-western boundary with a maximum depth between 0.3 to 0.6m and a maximum velocity less than 0.25m/s, with a maximum hazard rating of 'Caution'. In the 1% AEP event, there is a flow path along the south-western boundary with a maximum depth between 0.3 to 0.6m, a maximum velocity between 0.25 to 0.5m/s and a hazard rating of 'Danger to Some'. In the 0.1% AEP event, the site is bisected by a flow path in the central area flowing east to west, there is also encroachment from a flow path along the south-western boundary. Maximum depths are between 0.3 to 0.6m along the south-western boundary, with maximum velocities between 1.0 to 2.0m/s along the central flow path. The central flow path has a maximum hazard rating of 'Danger to Some' while the encroachment had a hazard rating of 'Danger to Most'. Furthermore, it is recommended that developers undertake Integrated Catchment Modelling (ICM) at the site as part of a site-specific FRA to assess risk from the culverted watercourses and interactions with surface water.
Reservoir	The site is shown to not be at risk of Dry Day and Wet Day reservoir flooding according to the Environment Agency's reservoir flood mapping.
Groundwater	The JBA Groundwater Flood Emergence Mapping (5m resolution) shows that half the site the site has groundwater levels less that 0.025m below the grounds surface at the western half of the site. The eastern half is at no risk from groundwater emergence. In the western half, Groundwater levels are indicated to be at or very near (within 0.025m) ground level and there is a risk of groundwater flooding at the surface during a 1% AEP event, which may flow to and pool within topographic low spots. Detention and attenuation features should be designed

	to prevent groundwater ingress from impacting hydraulic capacity and structural integrity. Additional site investigation work may be required to support the detailed design of the drainage system. This may include groundwater monitoring to demonstrate that a sufficient unsaturated zone has been provided above the highest occurring groundwater level. Below ground development such as basements are not appropriate at this site.
Sewers	The site is located within a postcode area with 17 incidences of sewer flooding from 1997,1999, 2000, 2005, 2015, 2016, and 2018 according to the Severn Trent Water Hydraulic Sewer Flood Risk Register.
Flood history	The site is not located in or near historic flood outlines in accordance with flood records provided by City of Wolverhampton Council and the Environment Agency's Historic Flood Map and Recorded Flood Outline Map datasets.
Flood risk management infrastructure	
Defences	The Environment Agency AIMS dataset that there no flood defences within or near the site.
Residual risk	The site encounters residual risk from the culverted watercourse underneath Mammoth Drive at the north-west boundary and the culverted Smestow Brook at the south-western boundary. These culverts pose a residual risk to the site in the event of a blockage, which could cause water to back up and encroach on the site. Through a Flood Risk Assessment (FRA) developers should seek modelling of blockage scenarios for the culverts, and modelling at the site as part of a site-specific FRA.
Emergency planning	
Flood warning	The site is not within an Environment Agency Flood Alert or Flood Warning Area.
Access and egress	Access to the site is from Mammoth Drive and Coxwell Avenue, with Coxwell Avenue connecting to the Stafford Road (A449) which provides access from the north and south. In the 3.3% AEP surface water event, access and egress within the site is maintained, however access to the site from Stafford Road may be impeded, where there is an area of ponding Coxwell Avenue that is slow moving but has depths between 0.6 to 0.9m, resulting in a hazard rating of 'Danger to Most'. Similarly to the 1% AEP surface water event, access and egress to the site from Coxwell Avenue is impeded as there is a large flow path along the road. The flow path has a maximum depth between 0.9 to 1.2m and a maximum velocity between 0.5 to 1.0m/s, with a hazard rating of 'Danger to Most'. In the 0.1% AEP surface water event, access within the site is impeded due to the flow path that bisects the site, and access and egress to the site is also impeded due to significant extents along the Stafford Road and Coxwell Avenue. Maximum depths in the flow path along Coxwell Avenue exceed 1.2m with a maximum velocity between 1.0 to 2.0m/s, with a predominant hazard rating of 'Danger to Most' and a maximum hazard rating of 'Danger to All'. The surface water design event (the 1% AEP plus 40% climate change allowance) has extents similar to the 0.1% AEP event and is likely to face the same access and egress issues. In the flow path along Coxwell Avenue, the maximum depth is 1.75m and a maximum velocity of 1.91m/s, resulting in a predominant hazard rating of 'Danger to Most' and a maximum hazard rating of 'Danger to All'. Arrangements for safe access and egress will need to be demonstrated for the 1% AEP plus an allowance for climate change rainfall events, using the depth, velocity, and hazard outputs. Any raising of access routes should not impede surface water flows or contribute to increasing flood risk off-site. If detailed modelling (including consideration of breach scenarios) suggests that the site

	is at significant risk of flooding which affects access routes, a Flood Warning and Evacuation Plan will be required.
Dry Islands	There is a dry island at the eastern boundary during the 0.1% AEP and design surface water events.
Climate change	
Implications for the site	**Management Catchment: Severn Midde Worcestershire** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding **Surface Water:** The design event for rainfall intensities is the upper climate allowance for the 2070s epoch. As such the design event is the 1% AEP + 40% CC. The extent of the design event has increased significantly, with the extent similar to that of the present day 0.1% AEP event. The design event has a maximum depth of 0.65m at the south-western boundary. With a significant increase in extent, the site is shown to be sensitive to increased surface water flood risk due to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.
Requirements for drainage control and impact mitigation	

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• The geology consists of:
	  ○ Bedrock formed of sandstone and interbedded conglomerate of undifferentiated Triassic Rock
	  ○ Superficial deposits predominantly consist of diamiction till, with the western corner comprised of glacial sands and gravels.
	• The soil is comprised of slowly permeable, seasonally wet, slightly acidic but base rich loamy and clayey soils.
	
	SuDS
	• Groundwater levels are indicated to be at or very near (within 0.025m) ground level and there is a risk of groundwater flooding at the surface during a 1% AEP event, which may flow to and pool within topographic low spots. Detention and attenuation features should be designed to prevent groundwater ingress from impacting hydraulic capacity and structural integrity. Additional site investigation work may be required to support the detailed design of the drainage system. This may include groundwater monitoring to demonstrate that a sufficient unsaturated zone has been provided above the highest occurring groundwater level. Below ground development such as basements are not appropriate at this site.
	• BGS data suggests that the underlying geology is likely to have variable permeability and should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff.
	• The site is within a Groundwater Source Protection Zone. Infiltration techniques may not be suitable and should only be used following the granting of any required environmental permits from the Environment Agency for Zones 2, 3 and 4 although it is possible that infiltration may not be permitted. Proposed SuDS should be discussed with relevant

	stakeholders (LPA, LLFA and EA) at an early stage to understand possible opportunities and constraints. • The entirety of the site is within an area designated by the Environment Agency as being a historic landfill site. A thorough ground investigation will be required as part of a detailed site-specific FRA, to determine potential mitigation for contamination and the impact this may have on SuDS. As such, proposed SuDS should be discussed with the relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • The site is within the River Stour (Worcestershire) – confluence Smestow Brook to confluence of River Severn Nitrate Vulnerability Zone, and in an undifferentiated Secondary Superficial Aquifer Designation Zone. As such, infiltration techniques may not be appropriate at the site in order to preserve water quality. • Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. While the site is Flood Zone 1 and classified as 'Less Vulnerable', there is surface water flood risk and significant access and egress issues, it is recommended that the Exception Test is applied at the site.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** Section 2 of the Level 2 SFRA and Sections 2 and 3 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within Wolverhampton. • Consultation with City of Wolverhampton Council, Severn Trent Water, and the Environment Agency should be undertaken at an early stage. • Developers should consult with Severn Trent Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan. • Development plans should use their Level 1 and 2 SFRA for Wolverhampton, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits.

- Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; Birmingham City Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers.
- **From the Black Country Core Strategy – Policy ENV5 (2011)**

  The Wolverhampton Local Plan succeeds the Black Country Core Strategy building upon policies from the Strategy. Until the Local Plan is adopted the Strategy still applies. Developers should ensure the correct policy is applied. The following development principles will apply to assist in both reducing the extent and impact of flooding:
  - incorporate Sustainable Drainage Systems (SuDS), unless it would be impractical to do so, in order to significantly reduce surface water run-off and improve water quality. The type of SuDS used will be dependent on ground conditions;
  - on sites requiring a Flood Risk Assessment, reduce surface water flows back to equivalent greenfield rates;
  - create new green space, increase tree cover and/or provide green roofs.

Guidance for site design and making development safe:

- The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG).
- Should built development be proposed within the 1% AEP surface water flood extent, careful consideration will need to be given to flood resistance and resilience measures.
- Developers should wherever possible open up underground culverts, and in a manner which improved biodiversity, amenity and natural drainage in accordance with the current River Basin Management Plans for the area
- Development must not take place over culverted watercourses and a suitable easement must be provided from the outside edge of the culvert.
- Where there is known or suspected culverted watercourse(s) either on or immediately downstream of a site, and where the Level 1 SFRA highlights that there may be a risk of flooding, developers should:
  - Confirm the location and presence of the watercourse (or otherwise) through ground-truthing strategic datasets and undertaking an assessment of the culvert extent and location
  - Confirm by survey, modelling and mapping the flood extents of the watercourse(s), as many of the flood outlines associated with such watercourses have been carried out at a broad scale and may not account specific local features, such as culverts, bridges and detailed topographical survey.
  - Design the development to accommodate the floodplain of the watercourse and mitigate against flooding to properties to the site. This should include a consideration of residual flood risk e.g. if a culvert were to block downstream.
- The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates.
- Arrangements for safe access and egress will need to be demonstrated for the 1% AEP pluvial events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs.
- In accordance with information supplied by Severn Trent Water, the site is likely to be served by the Barnhurst wastewater treatment

works, which has been assessed as "not expected be an issue… (to estimated spare capacity)" and "no scope to provide additional capacity" for surface water discharge into watercourses. As such surface water disposal measures (detailed in the broad-scale assessments of SuDS section) should be undertaken by the developer.

- Developers should adhere to CWC's guidance on SuDS as laid out in Policy ENV 13 – Sustainable Drainage Systems (SuDS) and Surface Water Management:
    - All developments must incorporate Sustainable Drainage Systems (SuDS) and provide for their adequate adoption, ongoing maintenance, and management over the lifetime of the development, in accordance with any surface water drainage strategy required for the development under Policy ENV12.
    - SuDS must be designed in accordance with Local Lead Flood Authority standards, as follows:
        - demonstrate application of the surface water discharge hierarchy: Re-Use (Water Harvesting); Infiltration; Discharge to a watercourse; Discharge to a surface water sewer; Discharge to a combined sewer;
        - manage surface run-off as close to the source as possible to reduce flood risk and improve water quality;
        - include mitigation within storage calculations for future climate change, designed to 100yr + Climate Change (currently 40%);
        - designed to accord with the Environment Agency's Guidance on Flood Risk and Coastal Change, Construction Industry Research and Information Association (CIRIA) guidance, and Department for Environment Food & Rural Affairs (DEFRA) non-statutory technical standards;
        - designed to be daylight (open), natural and contribute to the conservation and enhancement of biodiversity and green infrastructure in the wider area, as far as is practical and viable.
    - For all major developments, surface water flows must be reduced back to equivalent greenfield rates. If greenfield runoff rates are not considered to be feasible for viability or other reasons, then the developer must submit evidence demonstrating what the constraints to achieving this are and how their development will accommodate runoff rates that are as close as reasonably possible to greenfield rates.
    - For all minor developments, a minimum reduction of 30% over pre-development run-off rates will be required. Under no circumstances will post-development runoff rates that are greater than pre-development run-off rates be permitted.
    - A hydrogeological risk assessment must be provided where infiltration SuDS is proposed for anything other than clean roof drainage in a Source Protection Zone 1.
- Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
- Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to:
    - raise them as much as possible.
    - consider moving vulnerable uses to upper floors.
    - include extra flood resistance and resilience measures.
- Other examples of flood resistance and resilience measures include:
    - using flood resistant materials that have low permeability to at least 600mm above the estimated flood level.
    - making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level.

Key messages

The site is most affected by the 0.1% AEP and design (1% plus 40% climate change allowance) surface water events, with access and egress issues in the 1% AEP, 0.1% AEP, and design surface water events. There is also residual risk to the site from the two culverts that bound the site. Development may proceed if:

- The Exception Test shall be undertaken and passed. The vast majority of the site is shown to be at risk during the design surface water event, therefore part "b" of the Exception Test must be satisfied. If the Exceptions Test is failed, development is unlikely to be able to be proceed.
- A site-specific Flood Risk Assessment demonstrates that site users will be safe in the 1% AEP surface water events, including an allowance for climate change. This will need to use detailed surface water modelling to show that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk off site. Additionally, it is recommended that developers seek a new topographic survey of the site and its vicinity, as well as modelling of the culverted watercourses as part of a site-specific FRA.
- Safe access and egress can be demonstrated in the 1% AEP plus upper climate change surface water events. If this is not possible, an appropriate Flood Warning and Evacuation Plan is needed.
- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, including a site-specific Surface Water Drainage Strategy, and SuDS maintenance and management plan and supported by detailed modelling (as above), with development to be steered away from the areas identified to be at highest risk of surface water flooding within the site. This is in line with the sequential approach to site layout.
- Raise commercial finished floor levels 600mm above the 1 in 100-year plus climate change flood level. Protect and promote areas for future flood alleviation schemes.
- If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping Information

The key datasets used to make planning recommendations for this site were the Environment Agency's Flood Map for Planning and the Environment Agency's Risk of Flooding from Surface Water map. More details regarding data used for this assessment can be found below.

Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.
Climate change	The latest climate change allowances (updated May 2022) have been applied to the EA's RoFSW dataset.
Surface Water	The Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The Environment Agency's Risk of Flooding from Surface Water (RoFSW) has been used to define areas at risk from surface water flooding.