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

Site details	
Site Code	**H23**
Address	Former Gym, Craddock Street, Whitmore Reans
Area	1.2ha
Current land use	Brownfield – car park
Proposed land use	Residential
Flood Risk Vulnerability	More Vulnerable
Sources of flood risk	
Location of the site within the catchment	The site is located to the north of Craddock Street which borders the southern site boundary. The northern boundary of the site is adjacent to Waltho Street whilst the western site boundary borders an access road leading on to Craddock Street. The site is located in the Smestow Brook catchment, which is a tributary of the River Stour. The upstream reach of the Smestow Brook is heavily culverted for approximately 3.3km, and the source is situated in Springfield to the north-west of the city centre. The culverted section of this watercourse is situated 600m north of the site, whilst the nearest open channel section of the Smestow Brook is located approximately 1km west of the site which discharges into the River Stour approximately 15km south of the site. There is also an unnamed culverted watercourse which is situated 385m north of the site and converges with the culverted Smestow Brook approximately 715m north-west of the site.
Topography	Environment Agency 1m resolution LiDAR across the site shows that the majority of the site is relatively with elevations ranging from 119.5m AOD in the centre to 120m AOD in the north. Ground levels along the western and eastern boundaries increase to around 120.5m AOD and 121.4m AOD, respectively. Elevations are highest in the south of the site where more vegetation is present. Here, ground levels reach around 122m AOD. 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. It is recommended that developers undertake a topographical survey at the site to inform a site-specific Flood Risk Assessment.
Existing drainage features	The site is located 1km east of the open channel section of the Smestow Brook and 900m east of the Staffordshire and Worcestershire Canal. As previously mentioned, there are also culverted sections of watercourses situated between 385m and 600m north of the site. The area surrounding these culverted watercourses are urbanised and therefore highly constrained. There are small sections of vegetated areas in the south of the site which could facilitate drainage. Much of the site is paved and it is likely that there are connections to the existing surface water sewer network. There are no other drainage features in the vicinity of the site.

Critical Drainage Area	The site is not located within a Critical Drainage Area (CDA).
Fluvial and tidal	**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 entirety of the site and its surrounding area is within Flood Zone 1. There are also no modelled fluvial extents within or surrounding the site. The closest extent to the site, which is within Flood Zone 2, is situated approximately 765m north-west of the site.
Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 0% Max depth – n/a Max velocity – n/a **1% AEP** – 6.5% Max depth – 0.15 – 0.3m Max velocity – <0.25m/s **0.1% AEP** – 29.9% 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. 1% AEP event includes the 3.3% AEP event).* **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 unaffected by surface water flooding during the 3.3% AEP event. During the 1% AEP event, isolated ponding occurs along the access road within the centre of the site. Flood depths here reach 0.15 to 0.3m with flood water velocities of less than 0.25m/s. The resulting flood hazard rating is 'Low' to 'Danger for Some'. During the 0.1% AEP surface water event, the ponding within the site increases in extent and forms a flow path which converges with the flow paths along the access roads to the north and west of the site. Flood depths within the site reach 0.3 to 0.6m with maximum flood water velocities of 1.0 to 2.0m/s along the western boundary of the site. The resulting flood hazard rating is 'Very Low' to 'Danger for Some'. There are small areas in the east of the site which are classified as 'Danger for Most' where some of the deepest flooding is located.

Reservoir	The site and surrounding area is not shown to be at risk of reservoir flooding during the Wet or Dry Day scenarios, according to the Environment Agency mapping.
Groundwater	The JBA Groundwater Flood Emergence Mapping (5m resolution) shows the site is at negligible risk of flooding due to the nature of the geological deposits. This should be confirmed through additional site investigation work.
Sewers	The site is located within a postcode area with 8 incidences of sewer flooding, according to the Severn Trent Water Hydraulic Sewer Flood Risk Register.
Flood history	There are no records of historic flooding held by City of Wolverhampton Council or South Staffordshire Council that are within, or in close proximity to, the site. There are also no records of flooding within or surrounding the site according to the Environment Agency's Recorded Flood Outline and Historic Flood Map datasets.
Flood risk management infrastructure	
Defences	The Environment Agency AIMS dataset shows there are no formal flood defences within or surrounding the site. The nearest defences to the site are located along the Smestow Brook, approximately 850m north-west of the site. These are walls at Dunstall Water Bridge and have a design Standard of Protection of 5 years.
Residual risk	A section of the Smestow Brook, as well as an unnamed watercourse, are culverted between 385m and 600m north of the site. There is currently no detailed hydraulic modelling available along these sections of watercourse, and the EA's FMfP Flood Zones do not cover these areas. However, in the event of a culvert blockage, there is a possibility the site could be at fluvial flood risk caused by overspilling into the floodplain. It is recommended that Developers undertake detailed hydraulic modelling of culvert blockage scenarios as part of a site-specific Flood Risk Assessment.
Emergency planning	
Flood warning	The site is not within any of the Environment Agency's Flood Warning or Flood Alert Areas.
Access and egress	Access and egress to the site is currently via an access road to the west of the site which leads on to Craddock Street adjacent to the site's southern boundary. The site may also have pedestrian access to the north via Waltho Street. Site access and egress is unaffected by fluvial flooding, according to the Environment Agency's FMfP Flood Zones. There is also no detailed hydraulic modelling in the vicinity of the site. During the 3.3% AEP surface water flood event, access and egress to the north of the site remains unaffected. However, ponding occurs along Craddock Street to the south-west of the site which may impede access from the site's western boundary. Flood depths here reach 0.3 to 0.6m with maximum flood water velocities of 0.25 to 0.5m/s. The resulting flood hazard rating is 'Very Low' to 'Danger to Some', therefore vehicular access may be impacted. During the 1% AEP surface water flood event, ponding increases along Craddock Street and the access road to the west of the site. The is also some ponding along Waltho Street to the north of the site, as well as ponding along the access road through the centre of the site. Flood depths remain around 0.15 to 0.3m but increase to 0.3 to 0.6m along Craddock Street. Flood water velocities are largely less than 0.25m/s but increase to 0.25 to 0.5m/s along Craddock Street. The resulting flood hazard rating is 'Very Low' to 'Danger for Some'. The hazard rating increases to 'Danger for Most' along Craddock Street

	where the flood water velocities are fastest. Here, vehicular access is likely to be impacted. The 0.1% AEP and 1% AEP plus 40% allowance for climate change surface water events both affect the same access and egress routes. During both events, flow paths form along the access road to the west of the site, as well as large sections of Craddock Road and Waltho Street. The ponding along the road within the site also increases and converges with the aforementioned flow paths to the north and west of the site. Maximum flood depths during both events are between 0.6 to 0.9m along Craddock Street. Maximum velocities reach 1.0 to 2.0m/s during both events. The resulting flood hazard rating is 'Very Low' to 'Danger for Most'. The latter is situated where flood depths are deepest along Craddock Road in the 0.1% AEP and 1% AEP plus 40% climate change events, as well as along the access road within the centre of the site during the 1% AEP plus 40% climate change event. Where flood water is deepest at these locations, vehicular access will be impacted. Arrangements for safe access and egress will need to be demonstrated for the 1% AEP plus an allowance for climate change rainfall event, using the depth, velocity, and hazard outputs. If safe access and egress cannot be demonstrated, consultation with RMAs early on should be implemented to ensure appropriate flood evacuation plans are put in place for the sites. Given the site is shown to be at significant risk from surface water flooding and could be at residual risk in the event of a culvert blockage, a Flood Warning and Evacuation Plan will be required for this site if development is proposed within the area at risk.
Dry Islands	The northern and north-western parts of the site are located within a dry island during the 0.1% AEP surface water flood event.
Climate change	
Implications for the site	**Management Catchment: Severn Middle 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 is very similar to that of the present day 0.1% AEP event, with maximum depths of 0.5m in the centre of the site. These are similar to flood depths during the 0.1% AEP event which reach around 0.3 to 0.6m in the same location. Therefore, the site is not shown to be sensitive to 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 geology at the site is underlain by Wildmoor Sandstone Member which comprises sandstone.
	  ○ Superficial deposits at the site consist of Till, Devensian (diamicton).
	• The soil is comprised of slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils

	SuDS • The site is not considered to be susceptible to groundwater flooding, due to the nature of the local geological conditions. This should be confirmed with site investigations. • 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 located 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 site is not located within an historic landfill site. • The site is within the River Stour (Worcestershire) - confluence Smestow Brook to confluence River Severn Nitrate Vulnerability Zone. The site is also within the Principal Bedrock Aquifer Designation Zone as well as the Secondary (undifferentiated) 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. • SuDS are to be designed so that they are easy to maintain, and it should be set out who will maintain the system, how the maintenance will be funded and should be supported by an appropriately detailed maintenance and operation manual. • 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.
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. As the site is classified as 'More Vulnerable' and is at significant risk of surface water flooding during the 0.1% AEP and design flood event, it is recommended that the Exception Test be applied to 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 the 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 the 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; City of Wolverhampton Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers. • The scale of development in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Severn Trent Water at the earliest opportunity to agree a housing phasing plan. • **From the Black Country Core Strategy – Policy ENV5 (2011) Link here** 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. Detailed hydraulic modelling and a site-specific topographical survey should be carried out as part of an FRA. 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. • 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. • Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water. • Arrangements for safe access and egress will need to be demonstrated for the 1% AEP surface water event 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 ENV13 – 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 Lead Local 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 1% AEP plus an allowance for 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. ○ by raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level.

Key messages

The site is shown to be at surface water risk during the 1% AEP, 1% AEP plus 40% climate change, and 0.1% AEP surface water flood events. There are also access and egress issues during these surface water events. There is also the possibility of residual risk from the culverted sections of the unnamed watercourse and the Smestow Brook. The development may be able to proceed if:

- 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, 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.
- A site-specific Flood Risk Assessment will need to demonstrate that site users will be safe in the 1% AEP surface water event, including an allowance for climate change. These will need 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 of surface water flooding on the site and to neighbouring properties. It is recommended that Developers undertake detailed hydraulic modelling of culvert blockage scenarios as part of a site-specific Flood Risk Assessment to confirm whether the culverted sections of the Smestow Brook and unnamed watercourse pose a residual risk of flooding to the site. If the modelling shows the site to be at significant risk of fluvial flooding, the Exception Test will need to be satisfied.
- Safe access and egress can be demonstrated in the 1% AEP Upper End allowance for peak rainfall intensity for the 2070s epoch surface water event. If this is not possible, an appropriate Flood Warning and Evacuation Plan is needed. The site will need a specific Flood Warning and Evacuation Plan which considers the risk of culvert blockages.
- The development raises finished floor levels 600mm above the 1% AEP plus climate change flood level. Protect and promote areas for future flood alleviation schemes.

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) map has been used to define areas at risk from surface water flooding.