Greater Norwich Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables	
Site details	
Site Code	**CC08**
Address/Grid Ref.	King Street Stores, King Street/ 623701,307932
Area	0.21 hectares
Current land use	Brownfield
Proposed land use	Residential
Sources of flood risk	
Location of site within catchment	The site is in the south east area of the River Wensum catchment. The River Wensum is an Environment Agency designated main river and flows in a southerly direction past the site, gradually bending eastwards and flowing towards its confluence with the River Yare.
Existing drainage features	The site is located on the edge of the River Wensum. The river has been artificially modified through Norwich and the banks of the river have been enforced with steel and concrete. There are no additional watercourses within the site boundary or in close proximity to the site.
Fluvial	**Proportion of site at risk:** **FZ3b –** 0.5% **FZ3a –** 1% **FZ2 –** 5% **FZ1 –** 95% *The % Flood Zones quoted show the % 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, e.g. FZ2 includes the FZ3 %. FZ1 is the remaining area outside FZ2 (FZ2 + FZ1 = 100%).* **Available data:** Modelling has been completed for the River Wensum using TUFLOW. Both defended and undefended scenarios have been modelled and the defended scenarios have been used to assess the risk of flooding to the site. Limitations of the modelling are summarised in the Mapping Information section at the end of this table. Further modelling was undertaken to apply recent climate change uplifts to the fluvial model of the Wensum. **Flood characteristics:** Fluvial flooding from the River Wensum has a small impact on the site. For all modelled scenarios, flooding is limited to the eastern boundary. Depths are below 0.2m for the 5% AEP event, 0.4m for the 1% AEP event and 1m for the 0.1% AEP event. The modelled flood hazard along here is 'Low-Caution' for the 5% AEP event, 'Moderate- Dangerous for some people' for the 1% AEP event and 'Significant- Dangerous for most people' for the 0.1% AEP event.
Coastal and Tidal	The site is not at risk from coastal or tidal flooding.
Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 0% **1% AEP** – 0% **0.1% AEP** – 0% *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 includes the 3.3% AEP %)*

	Description of surface water flow paths: The entire site is at very low risk of surface water flooding, meaning the site is not at risk of surface water flooding during the 0.1% AEP event. During the 0.1% AEP flood event, there is a risk of flooding to King Street near the southern corner of the site. Depths are less than 0.3m and the hazard risk is 'Low- Caution'. The flow route shows water remains outside the southern boundary of the site as it drains into the River Wensum.
Reservoir	The site is not shown to be at risk of reservoir flooding from the available online maps.
Groundwater	The Environment Agency Areas Susceptible to Groundwater Flooding dataset, provided as 1km grid squares, shows the susceptibility of an area to groundwater flood emergence. The following comments can be made about groundwater flood risk: • The entire site is shown to have a <25% susceptibility to groundwater flood emergence. This assessment does not negate the requirement that an appropriate assessment of the groundwater regime should be carried out at the site-specific FRA stage.
Flood history	The Environment Agency's historic flooding and recorded flood outlines dataset has a record of flooding on the site. The source of flooding was attributed to the River Wensum and flooding occurred in 1912. The site is located in a postcode area which has previously experienced sewer flooding (as identified in the Level 1 SFRA).
Flood risk management infrastructure	
Defences	This site is not protected by any formal flood defences.
Residual risk	There is no residual risk to the site from flood risk management structures.
Emergency planning	
Flood warning	The site is not located in an Environment Agency Flood Warning Area.
Access and egress	The point of access and egress is on the west of the site from King Street. In terms of fluvial flood risk, only the eastern boundary of the site is affected therefore the site access and egress point is unlikely to be affected during a fluvial flood event. This remains the case in future, even considering the most extreme event (0.1% AEP) in the Upper end (+65%)) climate change scenario. In terms of surface water flood risk, there is a risk of flooding on King Street in front of the site during a 0.1% AEP flood event. However, depths remain below 0.3m and the hazard rating is 'Low-Caution' so it is unlikely to significantly impact access and egress.
Dry islands	The site is not located on a dry island.
Climate change	
Implications for the site	• The site is sensitive to increased fluvial flows in the River Wensum resulting from climate change. The extent does not increase significantly however the increase in depth and hazard rating is more significant. • The eastern boundary of the site is partly in future Functional Flood Zone 3b which is thehe 5% AEP plus the Upper End (+65%) climate change scenario. This results in flooding of depths up to 0.8m and a flood hazard rating of 'Significant- Dangerous for most'. This presents a significant increase in risk as depths are about 0.5m metre higher than during the present day 5% AEP event. • The eastern end of the site is in future Flood Zone 3a which is the 1% AEP plus the Upper End (+65%) climate change scenario. Flood depths are up to 1.2m during this scenario. The modelled flood hazardis 'Dangerous for all'. This is a significant increase in risk as during the present day 1% AEP event, the hazard rating only 'Moderate- Dangerous for some'. • An area in the east of the site is in future Flood Zone 2 which is the 0.1% AEP plus Upper End (+65%) climate change scenario. This results in flooding to depths up to 1.8m and a hazard rating of 'Extreme- Dangerous for all'. Maximum depths are nearly 1m greater than the present day 0.1% AEP scenario and the flood extent encroaches further onto the site. • During the 0.1% AEP event plus 80% climate change scenario (H++), the extent is similar to the Upper End (65%) scenario and the depths only increase by about 0.1m. • In terms of surface water flood risk, the modelled 1% AEP event plus 40% climate change does not show a significant increase in surface water flooding on the site.

	Proportions of the site in Future Flood Zones can be found in Table 6-2 of the Greater Norwich Level 2 SFRA Report
Requirements for drainage control and impact mitigation	

Broad scale assessment of possible SuDS	• Geology at the site consists of:
	  ○ Bedrock – Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation, Portsdown Chalk Formation (undifferentiated) – Chalk.
	  ○ Superficial – Alluvium (Clay, Silt, Sand and Gravel).
	• Most source control techniques are likely to be suitable. Mapping suggests that slopes may be unsuitable for selective source control techniques.
	• Infiltration may be suitable. Mapping suggests a medium risk of groundwater flooding and underlying soils may be permeable. Further site investigation should be carried out to assess potential for drainage by infiltration. If infiltration is suitable it should be avoided in areas where the depth to the water table is <1m. As the site is located within a Source Protection Zone, infiltration techniques should only be used where there are suitable levels of treatment although it is possible that infiltration may not be permitted. Additionally, proposed SuDS should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints.
	• Detention is unlikely to be feasible as mapping suggests mean site slopes are >5%. Feasibility of such options should be assessed as part of a site-specific assessment. If this feature is feasible a liner may be required to prevent the egress of groundwater.
	• Filtration techniques are unlikely to be feasible as mapping suggests mean site slopes are >5%. Feasibility of such options should be assessed as part of a site-specific assessment. If this feature is feasible it should be located where the depth to the water table is >1m, additionally a liner maybe required to prevent the egress of groundwater.
	• All forms of conveyance are likely to be suitable. Where the slopes are >5% features should follow contours or utilise check dams to slow flows. A liner maybe required to prevent the egress of groundwater.
	• Developers should investigate and consider in full all Suds options and demonstrate that SuDS are not appropriate where they are not implemented.
	• The site is not designated by the Environment Agency as previously being a landfill site.
	• Given the highly constrained nature of the site, a carefully considered and integrated flood resilience and sustainable drainage design suitable for the urban setting should be considered. For example, the use of rainwater harvesting and floodable areas at the ground flood level (for example outdoor open storage areas/ rain gardens that are usually dry) should be integrated into the overall design of the development.

Opportunities for wider sustainability benefits and integrated flood risk management	• Due to the size of the site, there is likely to be limited space for green infrastructure. It is recommended that areas of hard paving are designed to ensure that flood water can be stored during a flood event alongside the use of green features such as rain gardens and tree pits. • A resilient approach to urban design should be taken. Habitable floor levels must be above the 1% AEP flood level taking into account climate change upper end scenario with an allowance for freeboard- this is approximately 1.5m above ground level.
NPPF and planning implications	
Exception Test requirements	• The Local Authority will need to confirm that the sequential test has been carried out. The Sequential Test will need to be passed before the Exception Test is applied. • Residential development is classified as ‘More Vulnerable’. As the site is mostly covered by Flood Zone 1 with a small area in Flood Zone 2, the Exception Test is not required for the site. • It is recommended that the most at risk area, along the eastern boundary is left undeveloped or given over to less vulnerable use. • Part of the site however is in Future Flood Zone 3 and it is recommended that a precautionary approach is taken and the Exception Test is applied should development be proposed within this area, along the eastern boundary of the site.

Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** • At the planning application stage, a site-specific Flood Risk Assessment will be required as part of the development is located in Flood Zone 2. • All sources of flooding, particularly the risk of fluvial and surface water should be considered as part of a site-specific flood risk assessment. • The site-specific FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance, Norwich City Council's Local Plan policies, and the Norfolk County Council Lead Local Flood Authority's Statutory Consultee for Planning Guidance Document. • Consultation with the Local Authority, Lead Local Flood Authority and the Environment Agency should be undertaken at an early stage. • The development should be designed to ensure that mitigation measures are in place to ensure the development does not flood, or that ground level space is used for less vulnerable parts of the development. **Guidance for site design and making development safe:** • Flood resilient design is essential for this highly constrained urban site: • A resilient approach to urban design should be taken. Habitable floor levels must be above the 1% AEP flood level taking into account climate change (upper end scenario) with an allowance for freeboard- approximately 1.5m above ground level. • 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). • Safe access and egress will need to be demonstrated in the 1 in 0.1% AEP plus climate change fluvial and rainfall events, using the depth, velocity and hazard outputs. Ideally, the access route should be situated 300mm above the designed flood level and waterproofing techniques should be used where necessary. Raising of access routes must not impact on surface water flow routes or contribute to loss of floodplain storage. Alternatively, the risk could be managed through the inclusion of higher refuge and a Flood Response Plan that meets the requirements of the Local Council and their Emergency Planner. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. • Due to the highly constrained nature of the site, resilience measures will be required if buildings are situated in the flood risk area. It is recommended that the high risk area along the eastern boundary is given over to less vulnerable use however should development be proposed here, it is recommended that a water entry strategy is used(i.e. measures to reduce flood damage once water gets inside rather than trying to keep the water out). • Compensatory flood storage is required for any land raising and all proposed buildings (unless they are left open and allowed to accept flows) whenever there is built development on land within the 1% +35% climate change flood extent. • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, to ensure that runoff from the development is not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure there is no increase in runoff beyond current greenfield rates. • Areas at risk from surface water flooding should ideally be integrated into green infrastructure, which presents wider opportunities to improve biodiversity and amenity as well as climate change adaptation. An integrated flood risk management and sustainable drainage scheme for the site is advised. It is essential that a detailed model of surface water flooding, using the existing drainage system, topographical and asset survey is constructed at the FRA stage. This will determine the risk from surface water flooding further and to ensure that overland flows do not overwhelm future sustainable drainage features. • Brownfield sites should discharge surface water at the original pre-development (greenfield) runoff rate. If this is not possible, a significant reduction in the current rate of discharge should be achieved and agreed with the relevant drainage body (LLFA). • Developers should refer to Norfolk County Council's 'Norfolk County Council Lead Local Flood Authority Statutory Consultee for Planning Guidance Document' and the Level 1 SFRA for information on SuDS for guidance on the information required by the LLFA from applicants to enable it to provide responses to planning applications.
Key messages	

The development is likely to be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with habitable floor levels above the fluvial design flood event (1% AEP) taking into account climate change.
- 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).
- Space for surface water to be stored on the site is provided and rainwater harvesting should be considered.
- Brownfield sites should discharge surface water at the original pre-development (greenfield) runoff rate. If this is not possible, a significant reduction in the current rate of discharge should be achieved and agreed with the relevant drainage body (LLFA, IDB or Anglian Water).
- Safe access and egress routes must not be in the areas of high surface water risk or the 1% AEP fluvial design flood event (taking into account climate change). The main site access point would be from King Street to the west.
- A Flood Warning and Evacuation Plan should be prepared for the site.

Mapping Information

The key datasets used to make planning recommendations regarding this site were the broadscale 2D modelling outputs from the Environment Agency's Flood Map for Planning, River Wensum Flood Model and the 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	Climate change was modelled as part of the Level 2 SFRA strategic 2D modelling for the 2080s. This included Central (+25%), Higher central (+35%) and Upper end (+65%). Level 1 SFRA surface water climate change scenario model results were used to assess the risk of surface water flooding in the future.
Fluvial depth, velocity and hazard mapping	Fluvial depth, velocity and hazard mapping for present day has been taken from the existing River Wensum Model. For future depth, hazard and velocity, this has been modelled as part of the Level 2 SFRA. This should be explored further at site-specific stage.
Surface Water	The Risk of Flooding from Surface Water map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth and hazard mapping for the 1 in 0.1% AEP event is taken from the Environment Agency's Risk of Flooding from Surface Water mapping.