Greater Norwich Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables	
Site details	
Site Code	**R36**
Address/Grid Ref.	Mile Cross Depot/ 621510,310073
Area	4.39ha
Current land use	Brownfield
Proposed land use	Carried forward mixed use allocation
Sources of flood risk	
Location of site within catchment	The site is in the River Wensum catchment. The River Wensum is an Environment Agency designated main river and flows in an easterly direction through Norwich, towards its confluence with the River Yare. The site is located on the north bank of the river as it enters the city.
Existing drainage features	The site is to the north of the River Wensum upstream of Norwich city centre, set back approximately 150m from the river. A small ordinary watercourse runs along the south edge of the site, parallel with the River Wensum, and joins the River Wensum approximately 400m downstream of the site.
Fluvial	**Proportion of site at risk:** **FZ3b –** 0% **FZ3a –** 0% **FZ2 –** 10% **FZ1 –** 90% **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 strategic modelling are summarised in the Mapping Information section at the end of this table. The Environment Agency's Flood Zone mapping has been used in this assessment; this is based on 2D generalised modelling data. Further 2D modelling was undertaken to apply recent climate change uplifts to the fluvial model of the Wensum. **Flood characteristics:** Flooding modelling for the River Wensum primarily shows the south bank to flood at this location and as such the site is not at risk of flooding in either the 5% AEP or 1% AEP events. During the 0.1% AEP event the site is not at risk of flooding from the main River Wensum, however a narrow band extending 10-20m into the site along the southern edge of the site is at risk of flooding from the adjacent River Wensum tributary. Flood depths on the site in this scenario are modelled to remain below 0.3m and with a modelled flood hazard categorised as 'Caution' modelled, with shallow standing flood water.
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** – 2% Max depth 0.3-0.6m Max velocity >0.25m/s **1% AEP** – 6%

	Max depth 0.3-0.9m Max velocity >0.25m/s **0.1% AEP** – 15 % Max depth 0.6-0.9m Max velocity >0.25m *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:** In general, surface water flood risk on the site is limited to the eastern half of the site. During the 3.3% AEP event, surface water flooding on the site is minimal, limited to ponding up to 0.6m in depth in the east of the site, between the existing building and Mile Cross Road. The maximum modelled flood hazard for this area indicates 'Danger for some, particularly children'. During the 1% AEP event, the region between the existing building and Mile Cross Road in the east of the site is flooded with depths reaching up to 0.6m. A region of shallower flooding, up to 0.3m extends around the northern side of the building. The modelled flood hazard for most of this area is 'Dangerous for some', with faster flows at the boundary with Mile Cross road posing a hazard of dangerous for most. There are also some small regions of standing water up to 0.3m in depth along the southern edge of the site, with a low modelled flood hazard. During the 0.1% AEP event flood depths around the existing building are greater, reaching up to 0.9m between the boundary with Mile Cross Road and up to 0.6m around the north edge of the building. In this scenario water flows across the site from the entrance to Mile Cross Road and around the building before entering the watercourse along the southern edge of the site. Away from the building depths are shallower, reaching up to 0.3m. The maximum modelled flood hazard on the east of the site is 'Dangerous for most'.
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 between a 25% and 50% 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 no recorded history of flooding on the site. The site is 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	Most of the site is not located in an area covered by Environment Agency flood warnings. The southern edge of the site is covered by the Environment Agency's 'River Wensum, through Norwich' flood warning area. The southern edge is also within the Environment Agency's 'The River Wensum from New Costessey to Thorpe Bridge at Norwich' Flood Alert area.
Access and egress	There is one main access/egress point to the site, via Mile Cross Road to the east of the site. Access and egress are not likely to be affected by fluvial flooding even during the 0.1% AEP fluvial event. Access and egress remain unaffected even in the Upper End (+65%) climate change scenario, however as there is significant extent of flooding across the site in this scenario, a Flood Warning and Evacuation plan should be in place.

	Access and egress via Mile Cross Road may be affected by surface water flooding during the 0.1% AEP event however the modelled flood depths on Mile Cross Road reach up to 0.3m with a modelled Flood Hazard rating of 'Low'.
Dry islands	The site is not located on a dry island.
Climate change	
Implications for the site	• The site is sensitive to climate change causing increased fluvial flows in the River Wensum which back up the smaller tributary adjacent to the site, and overtops the River Wensum to flood into the adjacent tributary in most extreme scenarios. • The site is outside Future Flood Zone 3b and remains unaffected by fluvial flooding during the 5% AEP plus Upper End (+65%) scenario. • Future Flood Zone 3a which is the 1% AEP plus Upper End (+65%) scenario extends approximately 25m into the site along the southern edge. In this scenario, flood depths for this region reach up to 0.3m. This represents a significant increase in risk as currently the site is not affected during the 1% AEP event. • Approximately half the site (47%) of the site is in Future Flood Zone 2 and affected by flooding during the 0.1% AEP plus Upper End (+65%) scenario. In this scenario, flooding extends approximately 50m into the site from the southern edge in the west half of the site and surrounds the existing building on the eastern side of the site. Flood depths are deepest along the southern edge, near the watercourse and reach up to 1.2m in depth. The modelled flood hazard along the southern edge of the site indicates that conditions are 'Dangerous for all', with fast flowing deep water. Towards the centre of the site, depths are shallower, reaching up to 0.6m. • There is no further significant change in flood extent or depths between the 0.1% AEP plus Upper End (+65%) scenario and the 1,000 -year H++(+80%) scenario, the most extreme scenario modelled. • The modelled 1% AEP with 40% Climate Change Surface water flooding does not show a significant increase in surface water flooding on the site from present day. **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 & Soils**
	• 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 – River Terrace Deposits - Sand and Gravel.
	• Most source control techniques are likely to be suitable. Mapping suggests that permeable paving may have to use non-infiltrating systems given the possible risk both to and from groundwater.
	• 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 may be feasible provided site slopes are <5% at the location of the detention feature. If the site has contamination or groundwater issues, a liner will be required.
	• Filtration is probably suitable provided site slopes are <5% and the depth to the water table is >1m. If the site has contamination or groundwater issues, a liner will be required.
	• 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. If the site has contamination or groundwater issues, a liner will be required.
	• 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.

Opportunities for wider sustainability benefits and integrated flood risk management	• Due to the size of the site, there are likely to be opportunities for green infrastructure such as swales and attenuation to provide wider environmental and amenity benefits. It is recommended that areas of hard paving are permeable and consider existing surface water flow routes. • A resilient approach to urban design should be taken. Most of the site is not at risk during the 1% AEP fluvial flood, however any habitable floor levels along the southern edge must be above the 1% AEP flood level taking into account climate change upper end scenario with an allowance for freeboard. For the northern portion of the site, this is approximately 0.7m above ground level at the greatest. It is however recommended that the most at-risk area of the site, along the southern edge is left undeveloped.
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. • The NPPF classifies residential development as 'More Vulnerable'. As only a small area of the site is in Flood Zone 2, the Exception Test Is not required for the site. • The southern edge 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 residential development be proposed along the southern edge 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 may be required if the proposed development is located along the southern edge 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 recommended for this urban site, much of which lies in Future Flood Zone 2: ○ 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- approx. 0.7m 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. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. A Flood Warning and Evacuation plan should be in place for the site. Alternatively, risk could be managed by inclusion of a higher refuge and a flood response plan that meets the requirements of the Local Council and their Emergency Planner. • Compensatory flood storage is required for any land raising and all proposed buildings whenever there is built development on land within the 1% +35% climate change flood extent. • Resilience measures will be required if buildings are situated in flood risk areas. • 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 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. 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.
- The most at-risk area of the site, along the southern edge, is left undeveloped.
- 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 only site access point would be from Mile Cross Road to the east. 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 allowances (for the 2080s) were modelled as part of Level 2 SFRA. This included Central (+25%), Higher central (+35%) and Upper end (+65%).
Fluvial depth, velocity and hazard mapping	Fluvial depth and hazard mapping has been taken from the River Wensum model for present day, and for future flood zones this was modelling produced for 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 1% AEP event is taken Environment Agency's Risk of Flooding from Surface Water mapping.