Greater Norwich Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables	
Site details	
Site Code	**GNLP3054**
Address/Grid Ref.	St Marys Works, Duke Street/ 622790,309173
Area	1.05
Current land use	Commercial
Proposed land use	Mixed use
Sources of flood risk	
Location of site within catchment	The site is in the catchment of the River Wensum. The River Wensum rises between the villages of Colkirk and Whissonsett and flows flows through Fakenham and the Pensthorpe nature reserve, and on through Swanton Morley, Taverham and Norwich to its confluence with the River Yare.
Existing drainage features	The site is located approximately 135m from the River Wensum. The River Wensum is an Environment Agency designated main river and has been artificially modified through Norwich by the banks of the river being enforced with steel and concrete. There are no additional watercourses within the site boundary or near the site.
Fluvial	**Proportion of site at risk:** **FZ3b –** 0% **FZ3a –** 0% **FZ2 –** 74% **FZ1 –** 26% *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. Further modelling was undertaken to apply recent climate change uplifts to the fluvial model of the Wensum. **Flood characteristics:** Fluvial flooding associated with the River Wensum is wide in extent and is modelled to flood most of the site in an extreme event. The low-lying topography of the site and its location close to the River Wensum means that flood water flows onto the site. The site is not at risk of flooding during the 5% AEP and 1% AEP flood events. In the 0.1% AEP flood event. Flood depths on the site are up to 0.6m in depth across most of the site, with shallower levels of less than 0.2m in the south of the site and along the southern and eastern edge of the site. The modelled flood hazard shows that most of the site has a modelled flood hazard risk of 'Caution'. The northern and western parts of the site have a flood hazard rating of 'Dangerous for some'.

Coastal and Tidal	The site is not at risk from coastal or tidal flooding.
Surface Water	**Proportion of site at risk (RoFfSW):** **30-year** – 0% Max depth 0m, Max velocity 0m/s **1% AEP** – 0% Max depth 0m Max velocity 0m/s **0.1% AEP** – 14% Max depth 0.15m-0.3m 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 30-year %)* **Description of surface water flow paths:** There are two areas at risk of surface water ponding on the site. The site is not at risk of surface water flooding during the 30-year or 1% AEP flood events. In the 0.1% AEP flood event, surface water ponding is present in two pools in the centre of the site. Flood depths are >0.3m and do not pose a significant hazard.
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 entirety of the site has a >50%- <75% susceptibility to groundwater flood emergence from superficial deposits. 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. Flood history information provided in the Level 1 SFRA does not identify any historic flooding on or near the site. The site is not located in postcode that was identified as having previously experienced sewer flood flooding 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 in the Environment Agency's 'River Wensum, through Norwich' flood warning area. The site is also located in the 'The River Wensum from New Costessey to Thorpe Bridge at Norwich' flood alert area.
Access and egress	The site is only accessible from the east of the site, from Duke Street. In terms of fluvial flood risk, a significant part of the site is within the modelled 0.1% AEP flood extent. Flood depths could reach up to 0.5m during a flood event. Access and egress to the site could be affected as a result of flooding on the site flowing onto Duke Street, however depths are not significant, below 0.1m. In the future however, the entire site will be with Flood Zone 2 in the Upper End (+65%) climate change scenario and access/egress may be significantly impacted.

	The Risk of Flooding from Surface Water dataset shows that the site is affected by flooding during the 0.1% AEP flood event. Surface water flooding could affect access and egress to the site. Although flooding remains largely below 0.3m in depth at the access point and around the site during this event, access and egress are likely to be impacted based on the existing site layout. The site is currently accessed through Duke Street which is not at risk of surface water flooding. The depths, velocities, hazards, durations and speeds of onset of surface water and fluvial flooding along access/ egress routes should be investigated further in a site-specific assessment, to confirm whether access for emergency vehicles could still be obtained. In particular, access and egress in the future with regards to climate change should be assessed and if it is found to be significantly impacted, a shelter in situ policy adopted. Any development should include a safe facility for all residents to shelter during an extreme event, with floor levels above the maximum flood level during the 0.15 AEP event, with an allowance for freeboard. For this site this is approximately 1.5m above ground level.
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 in fluvial flows in the River Wensum. • The site is in future Flood Zone 3a which is the 1% AEP plus the Upper End (+65%) climate change scenario. Most of the site is at risk of flooding during this scenario with flood depths ranging between 0.1m and 0.7m. The north east of the site has a flood hazard rating of 'Dangerous for most' with lower hazard ratings of 'Dangerous for some' in the western and southern parts of the site, and a 'Caution' hazard rating in the centre of the site. • The entire site is in future Flood Zone 2 which is the 0.1% AEP plus the Upper End (+65%) climate change scenario. The 0.1% AEP plus the Upper End (65%) climate change scenario results in flooding across the site with depths of between 0.3m and 1.6m on the site. The highest depth areas are in the north and centre of the site. During this scenario, most of the site has a flood hazard rating of 'Dangerous for most', apart from a small area in the north western corner of the site which is at a lower flood hazard risk. • The modelled 1% AEP with 40% Climate Change Surface water flooding does not put the site at risk of flooding. **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 – Alluvium (Clay, Silt, Sand and Gravel).
	• Soils at the site consist of:
	  ○ Fen peat soils - peaty, naturally wet, mixed fertility very low to lime-rich Most source control techniques are likely to be suitable.
	
	SuDS
	
	• 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 techniques are 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	• The area of surface water ponding should ideally used for green infrastructure, which presents wider opportunities to improve biodiversity and amenity, as well as reducing flood risk.
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' development and commercial as 'Less Vulnerable'. As the site is mostly covered by Flood Zone 2, the Exception Test is not required for the site. The site is however in Future Flood Zone 3 and it is recommended that a precautionary approach is taken, and the Exception Test is applied.
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 the development is in Flood Zone 2. • All sources of flooding, particularly the risk of fluvial, surface water and groundwater 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:** • 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. If access/egress is not possible, the a shelter in situ policy will be required and the development must include a facility for all residents to shelter during an extreme event, above the 0.1% AEP flood

	level with an allowance for freeboard, approximately 1.4m above ground level. • 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. This will more challenging given the majority of the site is in Future Flood Zone 3. • Due to the highly constrained nature of the site, resilience measures will be required if buildings are situated in the flood risk area. Habitable floor levels must be above the 1% AEP flood level considering climate change (upper end scenario) with an allowance for freeboard- approximately 1m above ground level. • 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. 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::

- Areas in Flood Zone 1 and then 2 are used for the least vulnerable parts of the development in accordance with Table 2 in the NPPF.
- 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).
- 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.
- An integrated flood risk management and sustainable drainage solution is implemented.
- New developments should adopt exemplar source control SuDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff. Assessment for runoff should include allowance for climate change effects.
- 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).
- The site is accessed from Duke Street to the east of the site. There are areas of both fluvial and surface water flood risk in this area and along the road. Although flood depths are not shown to be significant during the 0.1% AEP flood event, flooding could impact access and egress to and from Duke Street during a flood event where the extent and depths of flooding were increased due to climate change.

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. Flood Zone 3b was produced for the Level 1 SFRA.

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.