Greater Norwich Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables	
Site details	
Site Code	**GNLP2163**
Address/Grid Ref.	Colegate Car Park, Friars Quay/ 623072,308982
Area	0.12ha
Current land use	Car Park
Proposed land use	Residential
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 50m 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 –** 21% **FZ1 –** 79% *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 modelled to flood the area around the site and overlaps a small part of the site boundary in an extreme event. The site topographic levels are higher than the surrounding area therefore flood water does not affect 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 water only affects a small part of the west and north of the site, along Corncutters Close and Colegate. Flood depths in this area are up to 0.65m and have a maximum modelled flood hazard rating of 'dangerous for most'. The site is surrounded by flood water which has a maximum depth of 0.6 m. The modelled flood hazard around the site varies and has a maximum level of 'Dangerous for most'.
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% Max depth 0m, Max velocity 0m/s **1% AEP** – 0% Max depth 0m Max velocity 0m/s **0.1% AEP** – 5% 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 3.3% AEP %)* **Description of surface water flow paths:** Two significant surface water flow paths are present along the site boundaries which may affect site access. A surface water flow path is present to the west of the site in Corncutters Close and flows south along the road towards Friars Quay. This flow path overlaps a small proportion of the western boundary of the site. The other flow path affects the existing northern access road (Colegate). The flow path flows from west to east, towards Fye Bridge Street. During the 3.3% AEP flood event, flooding is modelled to the east of Friars Quay. Flood depths are greatest (0.3m – 0.6m) further down the flow path and are shallower (0.15m-0.3m) closer to the site. These areas have a flood hazard rating of 'Caution' closer to the site and increases to 'Dangerous for some' further away from the site. In the 1% AEP and 0.1% AEP events, the extent of the flow path is significantly larger, and flooding is modelled to the north of the site. In the 1% AEP event, flood depths are still greatest in the eastern part of the flow path however these remain 0.15m-0.3m at the existing entrance to the site. The area to the north of the site has a flood hazard rating of 'caution' to 'dangerous for some'. Flood depths during the 0.1% AEP flood event remain 0.15m-0.3m at the existing entrance to the site however depths increase to 0.3m-0.6m just outside the site boundary. This area has a flood hazard rating of 'caution' to '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 north of the site has a >25%- <50% susceptibility to groundwater flood emergence from superficial deposits. • The south 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 datasets have 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.
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 currently only accessible from Colegate.

	In terms of fluvial flood risk, access and egress to the site is unlikely to be affected by fluvial flooding. This is because flooding associated with the River Wensum during the 0.1% AEP flood event only affects the north and north western part of the site where the site currently isn't accessible. In the 3.3% AEP surface water flood event, there is a small amount of surface water flooding modelled further down the access road to the site (Colegate) which should not significantly affect access to the site. In the 1% AEP event, flood extents are marginally greater across Colgate, however, flood depths are still likely to be less than 0.3m so access and egress are unlikely to be significantly affected. In the 0.1% AEP event, flood depths are between 0.3m to 0.6m and can be expected on Colegate, which could affect site access and egress. During this event the site could become a dry island, therefore any development should have a facility for residents to shelter in situ during an extreme event (0.1% AEP plus Upper End) for this site, this is approximately 1.m above ground level. In the future, under the Upper End (+65%) climate change scenario, the entire site is at risk during the 0.1% AEP event underscoring the need for a shelter in situ policy. 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.
Dry islands	The site has not been identified in the Level 1 SFRA as a dry island however due to the islanding effect of flood water from fluvial and surface sources, it has been identified that the site is a dry island.
Climate change	
Implications for the site	• The site is highly 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. This scenario results in flooding of the northern and western parts of the site. Flood depths during this scenario are shallower in the centre of the site (>0.1m) and become deeper along the northern and western boundary of the site (0.6m-0.9m). The flood hazard ratings on the site range from 'Caution' in the centre of the site to 'Dangerous for most' along the site boundaries. The 1% AEP plus the Upper Central (+35%) climate change scenario results in flooding along the western boundary of the site, on Corncutter Close. Flood depths during this scenario are less than 0.3m and has a flood hazard rating of 'caution' to 'dangerous for some'. This scenario presents a significant increase in risk to the site as during the present day 1% AEP flood event, the site is not at risk of flooding. • The entire site is in Future Flood Zone 2, which is the 0.1% AEP plus the Upper End (+65%) climate change scenario. Flood depths during all the 0.1% AEP climate change scenarios do not increase significantly between each of the climate change scenarios. The 0.1% AEP plus the Upper End (65%) climate change scenario results in flooding across the site with depths of between 0.6m and 1.75m. During this scenario, the site has a flood hazard rating of 'Dangerous for most'. • The modelled 1% AEP with 40% Climate Change Surface water flooding 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 & 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
	
	SuDS
	
	• 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 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 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 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 considering climate change upper end scenario with an allowance for freeboard, approximately 1.2m above ground level. • A shelter in situ for an extreme fluvial event must be designed into the building and supported by a flood warning and evacuation plan. Suitable shelter for all occupants of any buildings must be above the 0.1% AEP flood level considering climate change (upper end scenario), approximately 2.1m 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. The NPPF classifies residential development as 'More Vulnerable' development. As the site is mostly covered by Flood Zone 2, the Exception Test Is not required for the site. 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.
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 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: o A resilient approach to urban design should be taken. Habitable floor levels must be above the 1% AEP flood level considering climate change (upper end scenario) with an allowance for freeboard- approximately 1.2m above ground level. o A shelter in situ for an extreme fluvial event must be designed into the building and supported by a flood warning and evacuation plan. Suitable shelter for all occupants

	of any buildings must be above the 0.1% AEP flood level considering climate change (upper end scenario)- approximately 2.1m 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. Due to the significant fluvial risk posed to the site, a Flood Warning and Evacuation Plan must be prepared based on a policy of shelter in situ. • 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. • Due to the highly constrained nature of the site, resilience measures will be required if buildings are situated in the flood risk area. Due to the significant depths of flooding on the site, it is suggested that a water entry strategy is used for the site (i.e. measures to reduce flood damage once water gets inside rather than trying to keep the water out) • 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:

- 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 and a facility for all occupants to shelter above the extreme fluvial flood event (1,000 year) 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 only site access point would be from Colegate to the north. 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 strategic 2D modelling completed 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 Environment Agency's Risk of Flooding from Surface Water mapping.