

Stockton-On-Tees Borough Council Local Plan Potential Sites Assessment

Level 2 Strategic Flood Risk
Assessment - Site Screening

April 2018



Stockton on Tees Borough Council
Planning Development Services
Municipal Buildings
Church Road
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Revision History

Revision Ref / Date Issued	Amendments	Issued to
V1.0 / July 2017	-	John Dixon
V2.0 / September 2017	Updated to incorporate Council comments and inclusion of Tees Marshalling Yard site	John Dixon
V3.0 / October 2017	Updated following Council comments	John Dixon
V4.1 / March 2018	Updated to include modelling results for Boathouse Lane, a range of Water Compatible, Less Vulnerable and Essential Infrastructure for Billingham Riverside	John Dixon
V4.2 / April 2018	Boathouse Lane text altered to reflect email 27th March reflecting modification to the Local Plan which would see the Boathouse Lane site removed as an allocation	John Dixon

Contract

This report describes work commissioned by John Dixon, on behalf of Stockton-On-Tees Borough Council. Stockton-On-Tees Borough Council's representative for the contract was John Dixon. Alex Masters, Charlotte Lloyd-Randall and David Barton of JBA Consulting carried out this work.

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Purpose

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1 Local Plan Potential Development Site Screening

1.1 Introduction

To inform the Sequential Approach to the allocation of development through Stockton-On-Tees Borough Council's upcoming Local Plan, a Level 1 SFRA was completed¹. This report identified development sites where further, more detailed site specific assessment, was required to confirm the potential suitability of proposed development site with respect to flood risk. It is noted that no options for specific development or redevelopment within each site are available at this time.

There are three sites that have been taken forward from the Level 1 SFRA for a more detailed Level 2 screening assessment as shown on Table 1-1 below. Whilst three sites have been identified for further investigation, only Boathouse Lane and Billingham Riverside actually requires further assessment as part of the Level 2 appraisal. The Boathouse Lane site was identified for residential development and owing to the designated vulnerability was subject to Exceptions Testing. Billingham Riverside is subject to the Exception Test as uses include Essential Infrastructure. The remaining site Tees Marshalling Yard, whilst not requiring an Exception Test has been included following request by the Council in order to enhance the available understanding of flood risk and development issues. The assessment of this site have therefore been included for information only and include climate change flood levels and extent mapping. Modelled Flood depth and hazard mapping for each site is included for information in Appendix A which accompanies this report.

Table 1-1 Development sites

Site Name	Proposed use	Site Area (ha)	% Area within FZ2	% Area within FZ3A	% Area within FZ3b
Boathouse Lane Council have Removed from Allocation.	Residential	7.17	42.22	37.54	3.35
Billingham Riverside	A range of Water Compatible, Less Vulnerable and Essential Infrastructure	24.75	18.05	46.66	0.00
Tees Marshalling Yards	Residential	34.49	31.62	0.83	0.00

This report provides a summary table for each site which incorporates the following:

- Screening FRA;
- Outline drainage strategy;
- Level 2 Site Assessment.

Each assessment table that follows describes the likely tidal, fluvial, ground water, canal, reservoir and surface water (both offsite impacts and runoff generated by development) flood risks. In addition, flood risk mitigation options, including requirements for further assessment are provided.

Based on available flood modelling data, each summary table includes updated recommendations for the Council as to the likely suitability of development within each site in terms of flood risk.

Boathouse Lane - Removed from allocation

Following further review by Stockton-On-Tees Borough Council and consultation with the Environment Agency on flood modelling outcomes the Council have confirmed the intention to modify the Local Plan. This would see the Boathouse Lane site removed as an allocation. This is in accordance with the Council's Statement of Common Ground.

Information on Boathouse Lane, outlined in this Level 2 review, is included for information only.

Boathouse Lane is situated on the north bank of the River Tees upstream of the Tees Barrier and flood risk is therefore predominantly fluviially influenced. The proposed residential development is classified as More Vulnerable. The Level 1 SFRA has identified that a Level 2 assessment and Exception test is required due to the More Vulnerable classification and extents within Flood Zone 3a (38% of the site area). 42% of the site is within Flood Zone 2 meaning development on this element may be permitted subject to an appropriate Flood Risk concluding that the development is acceptable based on flood risk over the lifetime of the development and does not increase flood risk elsewhere. National Planning Policy Framework (NPPF)² does not permit More Vulnerable development within Flood Zone 3b (3% of the site area). To inform the assessment of potential mitigation measures additional hydraulic modelling has been undertaken to confirm if there will be any substantive impact on river levels if ground levels are raised across approximately 60% of the site (areas outside of Flood Zone 3a) with the remainder of the ground reduced to the adjacent bank top levels. This modelling, based on land raising within FZ2 and lowering within FZ3a within the EA River Tees model, is intended to be an initial screening review to understand the scale of likely impacts on river levels. Modelling is, therefore, subject to detailed development proposals and FRA.

Billingham Riverside

Whilst this site is partially located in Flood Zone 3a, the vulnerability classification for this site means that an Exception Test and Level 2 assessment is not required for development to proceed. The site has been taken forward for a further more detailed assessment at the request of the Council to enhance the understanding of flood risk and future development proposals. Billingham Riverside is located on the north bank of the River Tees, downstream of the Tees barrier meaning that any flood risk is predominantly tidally driven. The proposed Employment classification is classified as a range of Water Compatible, Less Vulnerable and Essential Infrastructure. Essential Infrastructure may be permitted within Flood Zone 3a (Exception Test required) assuming that a site specific Flood Risk Assessment concludes that the development is acceptable based on flood risk over the lifetime of the development and does not increase flood risk elsewhere.

Tees Marshalling Yard

The vulnerability classification for this site therefore means that an Exception Test and Level 2 assessment is not required for development to proceed. The site has been taken forward for further more detailed assessment at the request of the Council to enhance the understanding of flood risk and future development proposals. Tees Marshalling site is located on the south bank of the River Tees adjacent to the confluence with the old River Tees and adjacent to the Tees Barrier. Flood risk to this site appears to be predominantly tidally influenced. The proposed residential development is classified as More Vulnerable. As only 0.83% of the development site is located within Flood Zone 3a, the site does not require the Exception Test as it is likely that this area can be avoided / mitigated through site layout and design. 32% of the site is located within Flood Zone 2 and therefore in accordance with NPPF More Vulnerable development in this area may be permitted subject to a site specific Flood Risk Assessment concluding that development is acceptable based on flood risk over the lifetime of the development and does not increase flood risk elsewhere.

² National Planning Policy Framework. Department for Communities and Local Government, 2012 <https://www.gov.uk/government/publications/national-planning-policy-framework--2>

2 Site Appraisal Tables

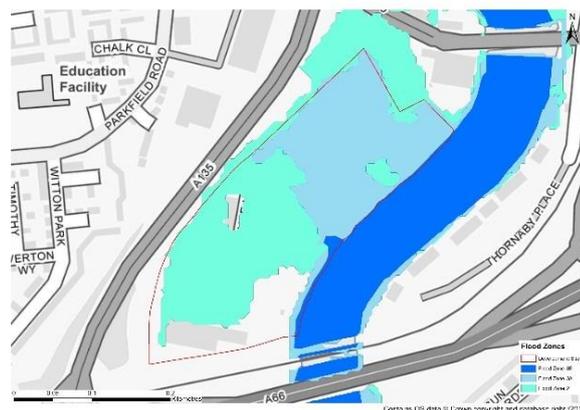
2.1 Boathouse Lane - Removed from allocation

Following further review by Stockton-On-Tees Borough Council and consultation with the Environment Agency on flood modelling outcomes the Council have confirmed the intention to modify the Local Plan. This would see the Boathouse Lane site removed as an allocation. This is in accordance with the Council's Statement of Common Ground.

Information on Boathouse Lane, outlined in this Level 2 review, is included for information only.

Site Area	Boathouse Lane
Site area	7.17Ha
Existing use	Mix Greenfield / Brownfield
Proposed use	Residential - Removed from allocation
Proposed development flood risk vulnerability classification	More Vulnerable
Proposed development impermeable area	75% of total area 5.38Ha

Flood outlines (current day)



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Site Area		Boathouse Lane	
Flood Source: Fluvial			
Flood Zones (%)	Flood Zone 2 0.1% AEP	Flood Zone 3a 1% AEP	Flood Zone 3b
	42.22	37.54	3.35
Flood Zone depth (m)	Max: >1.2 Mean: 0.6-0.9	Max: 0.3-0.6 Mean: 0.15-0.3	Max: >1.2 Mean: 0.3-0.6
Flood Zone hazard	Max: Significant Mean: Significant	Max: Significant Mean: Moderate	Max: Extreme Mean: Moderate
Climate change	<p>Fluvial climate change impacts have been assessed by increasing peak flows by the total potential change anticipated for the '2080s' (2070 to 2115) (highest specified % allowance) corresponding with the highest risk Flood Zone and the proposed development Vulnerability Classification.</p> <p>80% of this site is currently located within Flood Zone 2 and 3a.</p> <p>The EA flood map indicates that the site is at risk of flooding as a consequence of fluvial overtopping from the River Tees.</p> <p>The River Tees modelled climate change flood outlines indicates an increase in depths across the site of approximately 1m from the current day modelled depths. Flood depths across the majority of the site will be in excess of 2.0m for the 0.1% AEP + climate change event. The 1% and 0.1% AEP + climate change flood outlines will extend across almost the entirety of the site area with a Significant to Extreme flood hazard as indicated on the flood plans in Appendix A.</p>		
Historic flooding	The site is not contained within the Environment Agency Historic flood outline. From available data, there are no records of other historic flood events.		
Defended	The site is not located within an Environment Agency Area Benefitting from Defence and records indicate high ground along the frontage rather than formal defences.		
Flood Warning Area	100% of Site Area within River Tees at Thornaby Flood Warning Area		
Flood risk	<p>Generally, the low lying site is relatively level across the majority of the area with ground levels 3.5-4.5mOD. Immediately to the south of the site ground levels rises sharply in the form of an embankment (approximate level of 11mOD) where the rail line and A66 highway crosses the Tees. Ground levels continue to rise inland of the western site boundary.</p> <p>The Site Area is at greatest risk of flooding from the north-east where it adjoins River Tees. Approximately 85% of the site is at risk of fluvial flooding and located in Flood Zone 2, 3a and 3b. The majority of the site is located within Flood Zone 2 (depth of flooding in excess of 1.2m and average flood hazard rating of Significant). A large proportion of the site is also located within Flood Zone 3a (with a maximum depth of flooding of 0.3-0.6m in the 1% AEP event and a hazard rating of Significant). Furthermore part of the site is within Flood Zone 3b (depth of flooding is between 0.9-1.2 with an average flood hazard rating of Significant).</p> <p>The Environment Agency Flood Zone map indicates the extent of flooding in the absence of defences. The site is located adjacent to the River Tees so flooding would be considered instantaneous and to full depth and any development proposals would need to consider the suitability of existing defences and any enhancements required to manage residual risk.</p>		
Mitigation options & site suitability	<ul style="list-style-type: none"> Current flood risk and the associated depths of flooding within FZ3a means that the suitability of the site for residential (More Vulnerable) redevelopment must be considered in detail. Areas of FZ3a are currently at risk of flooding to depths of 0.6m (rising with climate change). With a hazard rating of moderate to significant, FZ3a would not be considered acceptable for residential development without implementation of significant flood mitigation measures. Hazard mapping 		

Site Area		Boathouse Lane		
	<p>shows those areas where current hazards within areas of FZ3a are considered lowest.</p> <ul style="list-style-type: none"> Development in areas covered by Flood Zone 2 may be difficult and land raising may result in a reduction in available flood storage. As flood risk is fluvially dominated at this location, further modelling has been undertaken to assess the potential impacts on river levels and offsite impacts as a consequence of land raising. This sensitivity assessment has indicated that increasing the ground levels across the areas outside of Flood Zone 3a to above the 0.1%+climate change flood level and reducing levels within Flood Zone 3a to bank top levels has a negligible impact on water levels in the River Tees or areas outside of the site in either the current day or climate change scenarios (less than 10mm). Compensatory works should aim to reduce overall flood risk. Whilst the modelled scenario reduces levels within Flood Zone 3a. and raises remaining levels, there are alternative options (making more sense in land assembly and master planning perspective) that may be acceptable. The detailed arrangement, economic and technical viability of land raising will be subject to future master planning and developer proposals. Other mitigation options such as land raising and the provision of compensatory storage in the form of underground attenuation may be appropriate but has not been considered within this report. Floodplain compensatory storage is a form of risk substitution, since it allocates land with a low risk use liable to flood more frequently. Due to the level of risk across this site (Flood Zone 2, 3a and 3b) a more detailed FRA will be required to reflect the site specific development proposals and to demonstrate that flood risk can be effectively managed without increasing risk elsewhere. As the proposed use is Residential and has been classified as a More Vulnerable site the FRA would have to show that the second part of the Exception Test has been satisfied in order for development to proceed. Provision for climate change should be made in the FRA ensuring the site will remain safe in the future, assuming current risk can be mitigated. Access (including emergency access) across the site will need to take account of future flood levels. It is noted that the adjacent Boathouse Lane is inundated to similar depths as the site within the undefended situation. 			
Flood Source: Ground Water				
Flood risk: ground water	15% of the site has less than 25% risk of flooding due to ground water. The remaining 85% of the site is not a risk of flooding from ground water.			
Flood Source: Infrastructure Failure – Reservoirs				
Flood risk: Reservoir	Published mapping indicates the entire site is within the extent of reservoir failure with flood depths of over 2m and a flow velocity of 0.5-2.0m/s across the area. Developers will need to consult with the Local Planning Authority as part of the FRA as the site area is within the envelope of reservoir flooding on published flood maps.			
Flood Source: Infrastructure Failure – Canals				
Flood risk: canal	A canal is located downstream of the site on the opposite bank of the River Tees. It is deemed that if this canal was breached, this would not have an impact on the site area. Therefore, the site does not appear to be at risk from infrastructure failure from the canal.			
Flood Source: Surface Water				
Surface Water Flood Risk to Proposed Development Site				
Existing development: risk of flooding from surface water (%)	High Risk (3.33% AEP outline)	Medium Risk (1% AEP outline)	Low Risk (0.1% AEP outline)	
	1.02	1.83	7.85	

Site Area		Boathouse Lane				
Surface water flooding depths		Max: 0.3-0.6 Average: 0.15-0.3		Max: 0.3-0.6 Average: 0.15-0.3		Max: 0.6-0.9 Average: 0.15-0.3
Surface water hazards		Max: Moderate Average: Low		Max: Moderate Average: Moderate		Max: Significant Average: Moderate
Climate change	The current day 1 in 1000-year outline provides an indication of the likely increase in depth and extent of the more frequent events as a consequence of climate change impacts.					
Surface water: flood risk to development site	<p>There is surface water flood risk to the area up to the 0.1% AEP (Low Risk) event. Overall approximately 11% of the site area is at some level of surface water flooding. Surface water flood extents appear to be influenced by the presence of the existing buildings and drainage infrastructure these extents are likely to change if the site layout is changed. Flood depths increase locally from 0.3-0.6m in the 3.33% AEP event to 0.6-0.9m in the 0.1% AEP event.</p> <p>Mapping does not indicate overland surface water flow routes into and across the site from adjacent areas.</p> <p>Surface water flooding of the surrounding highways will need to be taken into account in consideration of emergency access and egress, however mapping indicates a low flood risk to adjacent A135 and A1130 and therefore off site impacts on access and egress appear manageable.</p>					
Surface water: mitigation options & site suitability	<ul style="list-style-type: none"> • Surface water flooding appears localised and so should not impact significantly on the development potential across the majority of the site. However, localised development areas will need to consider surface water based on location. The development area is generally subject to a localised Moderate surface water flood hazard. However, a site specific detailed surface water assessment and drainage strategy will be required as part of any FRA. The FRA will need to mitigate climate change impacts across the lifetime of the development. • Areas subject to surface water flooding should ideally be kept free from development or alternatively flows should be redirected across the site using SuDs. • Whilst they appear to be minimal, the FRA should also assess the potential for offsite surface water impacts on the proposed development. This will need to include consideration of inflows from adjacent sites. • The FRA should consider any existing discharges to the River Tees and if these are proven, impacts on outfall capacity during high river flows will need to be assessed. • The FRA should consider the impacts of surface water flooding on access and egress routes both within and outside the site (including emergency routes). Surface water mapping indicates a lower flood risk for the A135 and A1130 and therefore off site impacts on access and egress appear manageable. 					
Indicative Surface Water Flood Risk From Proposed Development						
<i>(for Site Area in its Entirety)</i>						
Proposed development limiting runoff rate: Greenfield - IH124 Methodology				3.33% AEP:	49.5l/s	
				1% AEP:	58.8/s	
Design flood event (incl climate change)	Critical storm duration Hrs	Inflow volume m³	Outflow volume m³	Attenuation required m³	Time to empty (assuming no infiltration) Hrs	Total storage required: Area (Ha) and %

Site Area						
Boathouse Lane						
						of site area
3.33% AEP Rainfall+20%	10	3256	891	2365	27	0.16Ha 2.2%
3.33% AEP Rainfall+40%	12	4003	1069	2934	33	0.20Ha 2.7%
1% AEP Rainfall+20%	10	4317	1059	3258 (893m ³ of exceedance storage)	33.8	0.22Ha 3.0% (0.06Ha 0.8%)
1% AEP Rainfall+40%	18	5877	1604	4273 (1339m ³ of exceedance storage)	48	0.28Ha 4.00% (0.09Ha 1.3%)
Climate change	Application of the central (20%) and upper band (40%) potential change anticipated for climate change in the table above shows the estimated attenuation volumes for the 3.33% and 1% AEP rainfall events.					
Surface water: flood risk impacts from development site & mitigation	<p>In accordance with the requirements specified by Stockton on Tees Borough Council for developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1-in-1 year rainfall event and the 1-in-100 year rainfall event should be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event. For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1-in-1 year rainfall event and the 1-in-100 year rainfall event should never exceed the peak greenfield runoff rate for the same event. There may be an opportunity for development to discharge direct to the fluvial watercourse with a more detailed assessment of attenuation requirements.</p> <p>It is recognised that this site includes areas of brownfield and specific proposals for redevelopment will need to be provided as part of any FRA. This will need to take into account the Stockton on Tees Borough Councils requirements described above. To illustrate the potential attenuation and storage for site the table above identifies the required storage volumes for the proposed impermeable areas of the site if limiting greenfield equivalent run off rates are applied. These will need to be proportioned to actual impermeable development areas within the Site Area to provide an indication of attenuation / storage requirements.</p> <p>Attenuation volumes are presented for the critical storm duration for the 3.33% AEP (standard drainage design) and 1% AEP (exceedance) events for climate change for an assumed 75% impermeable area. To limit off site surface water flood impacts attenuation storage will be required, both for the design drainage and exceedance events.</p> <p>An FRA and appropriate drainage / attenuation strategy will be required. There are a variety of appropriate techniques which could be adopted ranging from oversized pipes or underground storage tanks to SuDS techniques and attenuation basins. As a guide to the likely land take associated with this the table presents the area of a 1.5m deep surface storage pond and the percentage of the total site area. SuDS and attenuation requirements should be considered at the master planning stage.</p>					
Observations and Recommendation	<ul style="list-style-type: none"> The Council has identified Boathouse Lane as a key regeneration site which they wish to allocate within the Local Plan for residential More Vulnerable led- 					

development. Therefore, this assessment has been carried out to further explore options regarding future development potential and to review how flood risk can be overcome as part of a strategically planned development.

- Approximately 18% of the site is located in Flood Zone 1 and is, therefore considered suitable for redevelopment.
- 3% of the site is located within Flood Zone 3b and in accordance with NPPF More Vulnerable development would not be permitted in this area.
- Based on current ground levels, 38% of the site is located within Flood Zone 3a with flood depths of 0.3-0.6m. Whilst development in 3a would be subject to the exception test, flood depths to 0.6m may limit the suitability of land for development without, for example, land raising.
- Climate change is likely to increase the depth, severity and extents of flooding to in excess of 1.2m across the majority of the site, with depths across the western half the site in excess of 2mOD under the 1%AEP + 50% climate change allowance scenario. This will likely mean that there will be a requirement to leave this area of the site free from development and explore options for ensuring flood risk is not increased elsewhere.
- Due to the level of risk across this site (Flood Zone 2, 3a and 3b) a more detailed FRA will be required to reflect the site specific development proposals and to demonstrate that flood risk can be effectively managed so that the site will be safe for the lifetime of the development without increasing risk elsewhere. As the proposed use is Residential and has been classified as a More Vulnerable site the FRA would have to show that the second part of the Exception Test has been satisfied in order for development to proceed.
- To assess land raising as a potential mitigation measure for areas outside of the current day Flood Zone 3a and 3b we have undertaken modelling to investigate the feasibility of land raising by modelling the impact on river levels by increasing ground levels to above the 0.1%AEP + 50% climate change allowance. No specific development layout has been assessed at this stage and modelling is intended to confirm the likely scale of impacts associated with land raising and compensatory storage. This has been assessed in combination with reducing ground levels in Flood Zone 3a to bank top level as a means of providing additional flood storage. No further optimisation has been undertaken at this stage.
- The sensitivity assessment for this scenario indicates that there is a nominal change in flood levels of less than 10mm within the River Tees as a consequence of land raising. Whilst this preliminary modelling demonstrates a nominal increase is it considered likely that an optimised solution would result in a no change scenario. The detailed arrangement, economic and technical viability of land raising will be subject to future masterplanning and developer proposals. Other mitigation options such as land raising and the provision of compensatory storage in the form of underground attenuation may be appropriate but has not been considered within this report.
- Surface water flooding appears localised and so should not impact significantly on the development potential across the majority of the site. However, localised development areas will need to consider surface water based on location. The development area is generally subject to a localised Moderate surface water flood hazard. However, a site specific detailed surface water assessment and drainage strategy will be required as part of any FRA. The FRA will need to mitigate climate change impacts across the lifetime of the development.
- Published Flood mapping identifies the site is at risk from Reservoir flooding. Published mapping indicates flood depths within a banding of over 2m. Developers will need to consult with the Local Planning Authority as part of the FRA as the site area is within the envelope of reservoir flooding on published flood maps.
- On the basis of this assessment it is reasonable to conclude that there are

Site Area	Boathouse Lane
	<p>approaches to the development of the site which would pass Part 2 of the exception test. It will be for future masterplanning and FRA to further consider flood risk and the most appropriate approach to development.</p>

2.2 Boathouse Lane - Flood Modelling updates

In order to understand flood risk and the likely implications of development further modelling has been undertaken. It is recognised that the Council see the Boathouse Lane site as a key area for regeneration. However, the site is susceptible to flooding during climate change scenarios in particular. The primary access to the site is understood to be via the Flood Zone 3 area.

Whilst no development layout has been defined for the site, modelling has been based on land raising or lowering only at this stage. No alternative land is available for offsite compensatory storage.

A summary of flood interactions is provided in the following sections.

2.2.1 Appendix A File Note 2017s5531 (11/09/17)

Mapping included in Appendix A defines areas of the site at risk of flooding during the 1% and 0.1% AEP scenarios.

Under climate change scenarios the entire development area is at risk of inundation during both the 1% and 0.1% AEP events.

2.2.2 Appendix B Email 2017s5531 (14/09/17)

In order to understand the impact of ground raising and lowering, options for lowering land located within existing Flood Zone 3a (to offset ground raising within FZ1 and FZ2) has been investigated further using the available ISIS model.

Mapping included as Appendix B indicates the relative difference mapping assuming Flood Zone 3 areas are lowered to provide additional flood storage. Modelling is based on the following adjustments to the site topography:

- Level lowered to 3m AOD in part of site within FZ3a
- Level raised to 7m AOD in part of site within FZ2
- Level raised to 10m AOD in part of site within FZ1

Scenarios were run for the 1%, 1%+CC25, 1%+CC50, 0.1% and 0.1%+CC25 AEP events.

Difference mapping demonstrates that development of Flood Zone 1 and 2 is achievable provided that Flood Zone 3 is adapted to provide additional flood storage. This mapping is based on preliminary modelling only at this stage and options are subject to design.

2.2.3 Appendix C File Note 2017s5531 (21/01/18) (including updated LiDAR)

The Council identified that site access would be achieved via land within Flood Zone 3. To ascertain the impact development within Flood Zone 3 further modelling has been undertaken in order to quantify the impact of land raising within this area.

We have remodelled with the Flood Zone 3 development area raised above flood levels for the 1%, 0.1% and 1%+CC50%. During the 1% event there is very localised flooding. Development results in a maximum increase in water level of 40mm, with water levels generally increasing by 20mm.

In an attempt to lower flood levels buffer strips running parallel to the river have been reintroduced into the model where ground levels remain unchanged. This approach reduces the extent of land raising within Flood Zone 3 but still represents some significant areas of land

raising within the Flood Zone 3 area. The results effectively demonstrate a slight increase in flood levels irrespective of any flood conveyance margin retained along the river bank. The setback development still includes infilling of the deepest areas within Flood Zone 3. It is, therefore, noted that land raising within Flood Zone 3 is likely to result in an increase in flood level within the river channel and on land upstream of the site. Whilst this increase in level is relatively small, flood levels nevertheless increase as a result of development.

Flood mapping is included as Appendix C.

2.2.4 Level 2 Outcome

Boathouse Lane - Removed from allocation

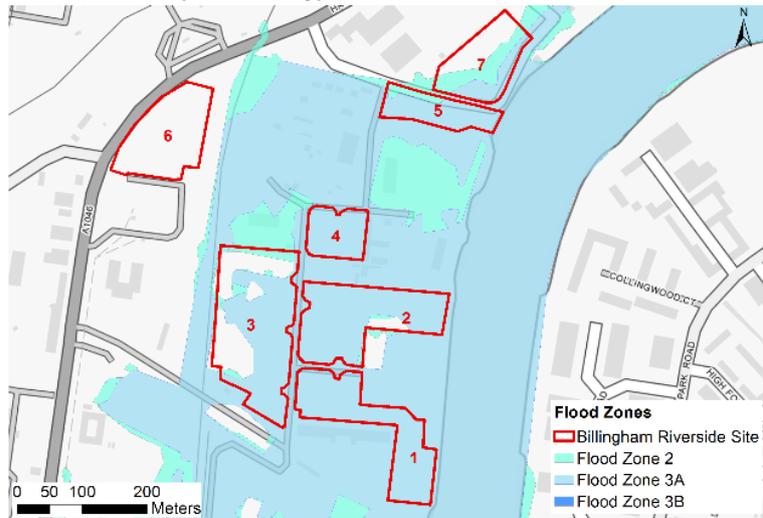
Following further review by Stockton-On-Tees Borough Council and consultation with the Environment Agency on flood modelling outcomes the Council have confirmed the intention to modify the Local Plan. This would see the Boathouse Lane site removed as an allocation. This is in accordance with the Council's Statement of Common Ground.

Information on Boathouse Lane, outlined in this Level 2 review, is included for information only.

2.3 Billingham Riverside

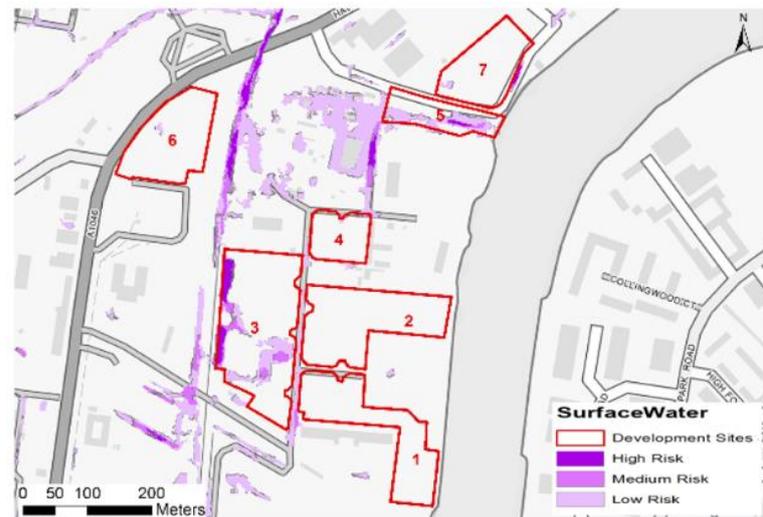
Site	Billingham Riverside - comprises of 11 individual sites
Site area	24.75Ha
Existing use	Mix Greenfield / Brownfield
Proposed use	Employment
Proposed development flood risk vulnerability classification	The Council have a range of classification proposed ranging from Water Compatible, Less Vulnerable and Essential Infrastructure
Proposed development impermeable area	75% of total area 18.56Ha

Flood outlines (current day)



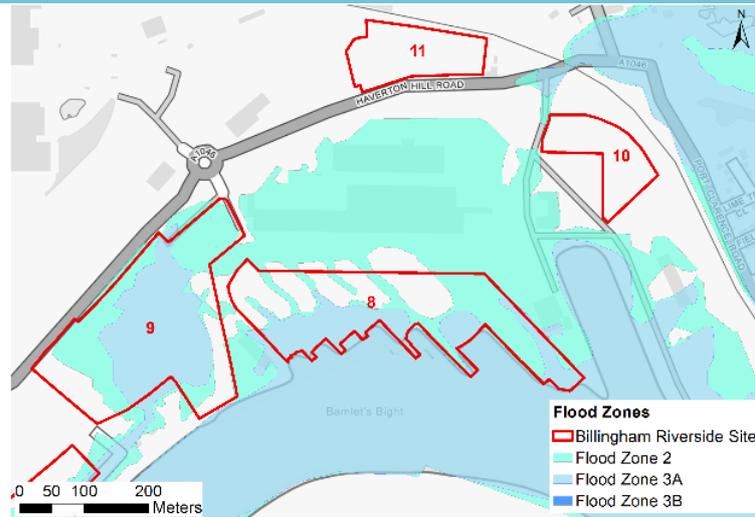
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Figure 1 - Flood Zones for sites 1 to 7



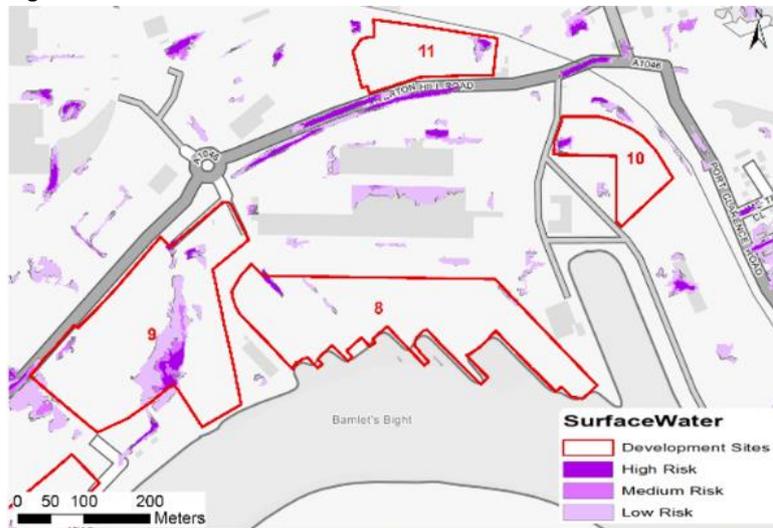
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Figure 2 - Surface Water Zones for sites 1 to 7



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Figure 3 - Flood Zones for sites 8 to 11



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Figure 4 - Surface Water Zones for sites 8 to 11

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Flood Source: Tidal

Billingham Riverside is defined as one site within the Level 1 SFRA however it consists of eleven sub areas.

Flood Zones (%) Across all Areas (1-11)	Flood Zone 2 0.1% AEP	Flood Zone 3a 0.5% AEP	Flood Zone 3b
	18.05	46.66	0.00
Flood Depth (m)	Max: >1.2 Mean: 0.9-1.2	Max: > 1.2 Mean: 0.9-1.2	NA NA
Individual Sites Flood Zone (%)			
Site 1	1.5	98.5	0.0
Site 2	0.7	94.1	0.0
Site 3	3.9	64.6	0.0

Site	Billingham Riverside - comprises of 11 individual sites		
Site 4	0.0	100.0	0.0
Site 5	0.4	99.6	0.0
Site 6	0.0	0.0	0.0
Site 7	1.8	58.5	0.0
Site 8	1.9	66.1	0.0
Site 9	3.0	77.2	0.0
Site 10	0.0	0.0	0.0
Site 11	0.0	0.0	0.0
Flood Zone depth Across all Sites (m)	Max: >1.2 (site 5-localised, site 8 localised to dock edge, Site 9 extensive) Mean: 0.6-0.9	Max: >1.2 (site 5-localised, site 8 localised to dock edge) Mean: 0.3-0.6	NA
Flood Zone hazard Across all Sites (from No Risk to Extreme for All Sites)	Max: Extreme (sites 1, 2, 4, 5 - extensive, site 3, 7, 8, 9 - partial) Mean: Extreme	Max: Extreme (sites 1, 2, 3, 4, 5, 8, 9 - partial, site 7 - localised) Mean: Extreme	NA
Climate change	<p>Climate change impacts have been assessed by reviewing the peak sea level, increasing it by the North East regional allowance for each epoch as identified in Table 3 of the GOV.UK Flood Risk Assessments: Climate Change Allowances guidance up to 2115.</p> <p>65% of the total combined site area is currently located with Flood Zone 2 and 3a.</p> <p>Modelling indicates under climate change the extents of both Flood Zone 2 and 3a will extend inland to cover approximately 78% of the combined site area. The climate change flood extents are indicated in Appendix A.</p> <p>Flood depths will vary across the site areas with mean flood depths increasing from 0.4m to 1.3m (0.5% AEP) and from 0.8m to 1.5m (0.1% AEP) across this area. The hazard rating will be similar (extreme) with the extents of each increased. It is noted that sites 6 and 11 remain within Flood Zone 1.</p>		
Historic flooding	<p>The site area is contained within the Environment Agency Historic flood outline. This shows the extent of sites which are recorded as having flooding. Billingham Riverside has been affected by reservoir flooding only. No data is provided on actual flood depths for flood events.</p>		
Defended	<p>The site area is not identified to be located within an Environment Agency Area Benefitting from Defence and records indicate high ground along the frontage rather than formal defences.</p>		
Flood Warning Area	<p>100% of site area within Tees Estuary at Portrack, Stockton on Tees and Middlesbrough Flood Warning Area.</p>		
Flood risk	<p>Generally, the low-lying sites are relatively level across the majority of the area with ground levels 3.5-5mAOD. Ground levels are highest at sites 6 and 11, with an average level of 8.5mAOD and 7.5mAOD respectively.</p> <p>The site area is at greatest risk of flooding from the east where it adjoins River Tees. In this area, the river is tidally dominated. Approximately 65% of the total area is at risk of tidal flooding and located in Flood Zone 2 and 3a.</p> <ul style="list-style-type: none"> • Sites 6, 10 and 11 are located entirely in Flood Zone 1. • Sites 1 to 9 are all partially or wholly located within Flood Zone 2 and 3a. 		

Site		Billingham Riverside - comprises of 11 individual sites	
	<p>The average flood depths and hazards vary across each site as identified in the flood depths and hazard plans in Appendix A</p> <p>The Environment Agency Flood Zone map indicates the extent of flooding in the absence of any defences.</p> <p>The site is located adjacent to the River Tees so flooding would be considered instantaneous and to full depth and any development proposals would need to consider the suitability of any existing high ground at the frontage of the site and any enhancements required to manage residual risk.</p>		
Mitigation options & site suitability	<ul style="list-style-type: none"> Emerging Local Plan policy directs port and river based uses to this location. Alternative employment uses may be acceptable where policy requirements are met. Where development is proposed within areas of higher risk they may be acceptable subject to land raising and a site specific FRA to confirm that the level of flood risk is acceptable for each individual site over the lifetime of the development and does not increase flood risk elsewhere. Managing this flood risk will be dependent on the feasibility / economic and technical viability of achieving required land raising which may result in a reduction in available flood storage. However in this instance, it is noted that this is an area of predominantly tidal flood risk and land raising is unlikely to impact on tidal levels. Sites 6 and 11 are located in Flood Zone 1 and is, therefore, considered suitable for redevelopment subject to a site specific FRA. Provision for climate change as per mapping should be made in the FRA ensuring the site will remain safe in the future, assuming current risk can be mitigated. Access (including emergency access) across the site will need to take account of future flood levels. The A1046 Haverton Hill Road to the north and east of the area appears to provide suitable access, although access routes from the individual sites to this point will need to be considered. 		
Flood Source: Ground Water			
Flood risk: ground water	All sites are less than 25% at risk of flooding from ground water.		
Flood Source: Infrastructure Failure – Reservoirs			
Flood risk: Reservoir	Sites 1, 2, 3, 4, 5 and 8 are at risk of flooding from reservoir failure. From the Environment Agency's flood map the average depth is less than 0.3m with localised areas of between 0.3m and 2m. The flood extent adjacent to site 8 indicates a depth in excess of 2m. Developers will need to consult with the Local Planning Authority as part of the FRA as the site area is within the envelope of reservoir flooding on published flood maps.		
Flood Source: Infrastructure Failure – Canals			
Flood risk: canal	A canal is located downstream of the site on the opposite bank of the River Tees. It is deemed that if this canal was breached, this would not have an impact on the site area. Therefore, the site does not appear to be at risk from infrastructure failure from the canal.		
Flood Source: Surface Water			
Surface Water Flood Risk to Proposed Development Site			
Existing development: risk of flooding from surface water (%) Across all Areas (1-11)	High Risk (3.33% AEP outline)	Medium Risk (1% AEP outline)	Low Risk (0.1% AEP outline)
	1.02	1.83	7.85
Surface water flooding depths Across all Areas (1-11)	Max: 0.3-0.6 Locally Average: 0.15-0.3	Max: 0.6-0.9 Locally Average: 0.15-0.3	Max: 0.6-0.9 Locally Average: 0.15-0.3

Site			
Billingham Riverside - comprises of 11 individual sites			
Surface water hazards Across all Areas (1-11)	Max: Moderate Locally Average: Moderate	Max: Significant Locally Average: Moderate	Max: Significant Locally Average: Moderate
Climate change	The current day 1 in 1000-year outline provides an indication of the likely increase in depth and extent of the more frequent events as a consequence of climate change impacts.		
Surface water: flood risk to development site	<p>There is no surface water flood risk to sites 1, 2, 4, 6 and 7 for the 1% AEP event. Only sites 1 and 2 are at no surface water flood risk up to the 0.1% AEP event. Overall approximately 62% of the entire site area is at some level of surface water flood risk. As the surface water flood extents appear to be influenced by the presence of the existing buildings and drainage infrastructure these extents are likely to change if the site layout is changed. Mapping identifies that there are certain sites (particularly Site 5 and 9) where there are potentially overland surface water flow routes into and across the Development Area from adjacent areas. Others sites appear to receive surface water locally from adjacent roadways. Whilst discharge of these sites is unconfirmed if they outflow to the River Tees, this may impact the discharge capability during high river levels and therefore these should be assessed as part of the FRA.</p> <p>Surface water flooding of the surrounding highways will need to be taken into account in consideration of emergency access and egress, however mapping indicates a low flood risk to Haverton Hill Road and therefore off site impacts on access and egress appear manageable.</p>		
Surface water: mitigation options & site suitability	<ul style="list-style-type: none"> • Surface water flooding appears localised and so should not impact significantly on the development potential across the majority of the sites. However, localised development areas will need to consider surface water based on location. The development area is generally subject to a low surface water flood hazard. However, a site specific detailed surface water assessment and drainage strategy will be required as part of any FRA. The FRA will need to mitigate climate change impacts across the lifetime of the development. • Areas subject to surface water flooding should ideally be kept free from development or alternatively flows should be redirected across the site using SuDs. • The FRA should also assess the potential for offsite surface water impacts on the proposed development. This will need to include consideration of inflows from adjacent sites. • The FRA should consider discharge to the River Tees and if these discharge routes are proven, impacts on outfall capacity during high tidal / river flows will need to be assessed. • Individual FRAs should consider the impacts of surface water flooding on access and egress routes both within and outside the site (including emergency routes). Surface water flooding of the surrounding highways will need to be taken into account in consideration of emergency access and egress, however mapping indicates a low flood risk to Haverton Hill Road and therefore off site impacts on access and egress appear manageable. 		

Site						
Billingham Riverside - comprises of 11 individual sites						
Surface Water Flood Risk From Proposed Development (for Site Area in its Entirety)						
Proposed development limiting runoff rate: Greenfield - IH124 Methodology				3.33% AEP:	171.2l/s	
				1% AEP:	203.5l/s	
Design flood event (incl climate change)	Critical storm duration Hrs	Inflow volume m ³	Outflow volume m ³	Attenuation required m ³	Time to empty (assuming no infiltration) Hrs	Total storage required: Area (Ha) and % of site area
3.33% AEP Rainfall+20%	10	11,201	3082	8119	26	0.54Ha 2.2%
3.33% AEP Rainfall+40%	12	13571	3698	9873	33	0.66Ha 2.7%
1% AEP Rainfall+20%	10	14820	3663	11157 (3037m ³ of exceedance storage)	30	0.74Ha 3.0% (0.2Ha 0.8%)
1% AEP Rainfall+40%	18	20824	5547	14737 (4864m ³ of exceedance storage)	41.4	0.98Ha 4.0% (0.32Ha 1.3%)
Climate change	Application of the central (20%) and upper band (40%) potential change anticipated for climate change in the table above shows the estimated attenuation volumes for the 3.33% and 1% AEP rainfall events.					
Surface water: flood risk impacts from development site & mitigation	<p>In accordance with the requirements specified by Stockton on Tees Borough Council for developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1-in-1 year rainfall event and the 1-in-100 year rainfall event should be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event. For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1-in-1 year rainfall event and the 1-in-100 year rainfall event should never exceed the peak greenfield runoff rate for the same event.</p> <p>For some of these sites there may be an opportunity for development to discharge direct to tidal watercourse sea and attenuation in that instance may not be required. It is recognised that this site area includes areas of brownfield and specific proposals for redevelopment will need to be provided as part of any FRA. This will need to take into account the Stockton on Tees Borough Councils requirements described above. To illustrate the potential attenuation and storage for site areas the table above identifies the required storage volumes for the proposed impermeable areas of the site area if limiting greenfield equivalent run off rates are applied. These will need to be proportioned to actual development site areas within each site area to provide an indication of attenuation / storage requirements.</p> <p>Attenuation volumes are presented for the critical storm duration for the 3.33% AEP (standard drainage design) and 1% AEP (exceedance) events for climate change. To limit off site surface water flood impacts attenuation storage will be required, both for the design drainage and exceedance events.</p>					

Site	Billingham Riverside - comprises of 11 individual sites
	<p>An FRA and appropriate drainage / attenuation strategy will be required. There are a variety of appropriate techniques which could be adopted ranging from oversized pipes or underground storage tanks to SuDS techniques and attenuation basins. As a guide to the likely land take associated with this the table presents the area of a 1.5m deep surface storage pond and the percentage of the total site area. SuDS and attenuation requirements should be considered at the master planning stage.</p>
<p>Observations and Recommendation</p>	<p>The Council will provide the strategic justification for inclusion of this site. No specific development proposals have currently been identified.</p> <p>The allocation is identified as a range of Water Compatible, Less Vulnerable and Essential Infrastructure by Stockton on Tees Council owing to its proximity to the existing industrial / Ports facility. Stockton on Tees Council identify that the optimum location to minimise environmental impacts for this use is one that is away from residential communities and is accessible to port facilities.</p> <p>Further land raising, or raised infrastructure may be considered as part of longer term essential infrastructure planning as this approach will not increase risk elsewhere. This will need to be considered further and confirmed as part of a site specific Flood Risk Assessment. The Council's policy for this site details a range of potential uses. Proposals for port and river based uses will be directed to sites and premises at Billingham Riverside, which includes approximately 38 hectares of available land.</p> <p>The following uses are considered to be suitable at this port and riverside location:</p> <ul style="list-style-type: none"> • Operational facilities, including wharves, jetties, slipways; • River based logistics, warehousing, hard standing, and storage; • Storage of hazardous substances awaiting import or export • Fabrication, maintenance or decommissioning of marine vessels, oil rigs and other large structures requiring transportation by sea; and • Energy generation plants and infrastructure that are reliant on a port/riverside location. <p>Emerging policy EG4(4) identified that alternative employment uses may be supported at Billingham Riverside if:</p> <ul style="list-style-type: none"> • The proposal complements anticipated investment in the area; or, • There are no other locations within the employment land portfolio which can accommodate the proposed development; or • The proposed development is essential for sustainable development, operational relationships with existing processes in the area, or other sustainability considerations. <p>Proposals which require hazardous substance consent will be designed and located to prevent an unacceptable increase in the level of risk to human health and the environment from an industrial accident or prejudice adjacent operational facilities or allocated sites.</p> <p>Due to the level of risk across this site (Flood Zone 2 and 3a) a more detailed FRA will be required to reflect the site-specific development proposals for each individual area and to demonstrate that flood risk can be effectively managed for the lifetime of the development without increasing risk elsewhere. As the proposed use is Industrial and has been classified as a range of Water Compatible, Less Vulnerable and Essential Infrastructure designations the FRA would have to show that the second part of the Exception Test has been satisfied in order for development to proceed.</p> <p>Where development within areas of higher risk are proposed a site specific FRA to confirm that the level of flood risk is acceptable for each individual site over the lifetime of the development and does not increase flood risk elsewhere. Managing</p>

this flood risk will be dependent on the feasibility to achieve required land raising which may result in a reduction in available flood storage. However in this instance, it is noted that this is an area of predominantly tidal flood risk and land raising is unlikely to impact on tidal levels.

On this basis of this assessment it is reasonable to conclude that the Part 2 of the exception test can be passed and the sites are suitable for allocation.

Site 1: Recommendation: Consider Site Layout & Design

Currently 98.5% of the site is located within Flood Zone 3a with depths of up to 0.3-0.6m over parts of the site under the 0.5% AEP current day scenario. Under climate change the site is subject to an Significant hazard rating with depths of up to 1.3m for a 0.5% AEP climate change event. There is no surface water flood risk to this site for the 0.1% AEP event. The site cannot be developed without significant mitigation in terms of increasing development levels and given the extents it is not likely to be possible to zone development to areas outside the areas of most significant flood risk. Due to the level of current and future flood risk across this site a more detailed FRA will be required to reflect the site-specific development proposals and demonstrate that flood risk can be effectively managed over the lifetime of the development without increasing risk elsewhere. The FRA will need to show that it is feasible to raise ground levels for development to proceed, without increasing flood risk elsewhere and include an emergency access plan demonstrating safe access.

Site 2: Recommendation: Consider Site Layout & Design

Currently 94.1% of the site is located within Flood Zone 3a with depths of up to 0.3-0.6m under the 0.5% AEP current day scenario. Under climate change the site is subject to an Significant hazard rating with depths of up to 1.5m for the 0.5% AEP climate change event . There is no surface water flood risk to this site for the 0.1% AEP. The site cannot be developed without significant mitigation in terms of increasing development levels and given the extents it is unlikely to be possible to zone development to areas outside the areas of most significant flood risk. Due to the level of current and future flood risk across this site a more detailed FRA will be required to reflect the site-specific development proposals and demonstrate that flood risk can be effectively managed over the lifetime of the development without increasing risk elsewhere. The FRA will need to show that it is feasible to raise ground levels for development to proceed, without increasing flood risk elsewhere and include an emergency access plan demonstrating safe access.

Site 3: Recommendation: Consider site layout and design

Currently 64.6% of the site is located within Flood Zone 3a with localised depths of up to 0.6-0.9m over parts of the site under the 0.5% AEP current day scenario. Under climate change the site is subject to an Significant hazard rating with depths of up to 1.5m for a 0.5% AEP climate change event. There is localised surface water flood risk to this site with depths of up to 0.3-0.6m. The site cannot be developed without significant mitigation in terms of increasing development levels. Given that there are areas outside of the zone of significant flood depth it may be possible to design the site layout to avoid the areas of most significant risk, in combination with land raising across the site. Due to the level of current and future flood risk across this site a more detailed FRA will be required to reflect the site-specific development proposals and demonstrate that flood risk can be effectively managed over the lifetime of the development without increasing risk elsewhere. The FRA will need to show that it is feasible to raise ground levels for development to proceed, without increasing flood risk elsewhere and include an emergency access plan demonstrating safe access.

Site 4: Recommendation: Consider site layout and design

Currently 100% of the site is located within Flood Zone 3a with depths of up to 0.3-

0.6m under the 0.5% AEP current day scenario. Under climate change the site is subject to a Significant hazard rating with depths of up to 1.3m for the 0.5% AEP climate change event. There is no surface water flood risk to this site for the 0.1% AEP event. The site cannot be developed without significant mitigation in terms of increasing development levels and given the extents it is unlikely to be possible to zone development to areas outside the areas of most significant flood risk. Due to the level of current and future flood risk across this site a more detailed FRA will be required to reflect the site-specific development proposals and demonstrate that flood risk can be effectively managed over the lifetime of the development without increasing risk elsewhere. The FRA will need to show that it is feasible to raise ground levels for development to proceed, without increasing flood risk elsewhere and include an emergency access plan demonstrating safe access.

Site 5: Recommendation: Consider site layout and design

Currently 99.6% of the site is located within Flood Zone 3a with depths locally in excess of 1.2m (generally 0.3-0.6m) under the 0.5% AEP current day scenario. Under climate change the site is subject to a Significant hazard rating with depths of up to 1.6m for the 0.5% AEP climate change event. There is surface water flood risk across much of this site with depths of up to 0.6-0.9m in the 0.1% AEP event. The site cannot be developed without significant mitigation in terms of increasing development levels and given the extents it is unlikely to be possible to zone development to areas outside the areas of most significant flood risk. Due to the level of current and future flood risk across this site a more detailed FRA will be required to reflect the site-specific development proposals and demonstrate that flood risk can be effectively managed over the lifetime of the development without increasing risk elsewhere. The FRA will need to show that it is feasible to raise ground levels for development to proceed, without increasing flood risk elsewhere and include an emergency access plan demonstrating safe access.

Site 6: Recommendation: Site-specific FRA required

Currently the site is not located within a Flood Zone and is not impacted under climate change and therefore would be considered suitable for development subject to a site specific Flood Risk Assessment.

Site 7: Recommendation: Consider site layout and design

Currently 58.5% of the site is located within Flood Zone 3a with depths locally in excess of 0.3-0.6m under the 0.5% AEP current day scenario. Under climate change the site is subject to a Significant hazard rating with depths of up to 1.6m (generally in excess of 0.6m) for the 0.5% AEP climate change event. There is only localised surface water flood risk to this site with depths of up to 0.3-0.6m in the 0.1% AEP event. The site cannot be developed without significant mitigation in terms of increasing development. Given that there are areas outside of the zone of significant flood depth it may be possible to design the site layout to avoid the areas of most significant risk, in combination with land raising across the site. Due to the level of current and future flood risk across this site a more detailed FRA will be required to reflect the site-specific development proposals and demonstrate that flood risk can be effectively managed over the lifetime of the development without increasing risk elsewhere. The FRA will need to show that it is feasible to raise ground levels for development to proceed, without increasing flood risk elsewhere and include an emergency access plan demonstrating safe access.

Site 8: Recommendation: Consider site layout and design

Currently 66.1% of the site is located within Flood Zone 3a with depths locally in excess of 1.2m under the 0.5% AEP current day scenario, although these appear to relate to the existing sloping slipways to the south of the site. Under climate change the site is subject to a Significant hazard rating with depths in excess of 2m

at the slipway and depths of 0.6-0.9m extending across more significant areas of the site for the 0.5% AEP climate change event. There is only very localised surface water flood risk to this site with depths of up to 0.15-0.3m in the 0.1% AEP event. The site cannot be developed without significant mitigation in terms of increasing development. Given that there are areas outside of the zone of significant flood depth it may be possible to design the site layout to avoid the areas of most significant risk, in combination with land raising across the site. Due to the level of current and future flood risk across this site a more detailed FRA will be required to reflect the site-specific development proposals and demonstrate that flood risk can be effectively managed over the lifetime of the development without increasing risk elsewhere. The FRA will need to show that it is feasible to raise ground levels for development to proceed, without increasing flood risk elsewhere and include an emergency access plan demonstrating safe access.

Site 9: Recommendation: Consider site layout and design

Currently 77.2% of the site is located within Flood Zone 3a with depths locally in the range 0.6-0.9m across the centre of the site under the 0.5% AEP current day scenario. Under climate change the site is subject to a Significant hazard rating with a localised areas of Extreme hazard to the south. Depths are in excess of 1.2m across the majority of the site and locally these can reach up to 2.8m for the 0.5% AEP climate change event. There are significant areas of surface water flood risk across the centre of this site with depths of up to 0.3-0.6m in the 0.1% AEP event. The site cannot be developed without significant mitigation in terms of increasing development. The site cannot be developed without significant mitigation in terms of increasing development levels and given the extents it is unlikely to be possible to zone development to areas outside the areas of most significant flood risk. Due to the level of current and future flood risk across this site a more detailed FRA will be required to reflect the site-specific development proposals and demonstrate that flood risk can be effectively managed over the lifetime of the development without increasing risk elsewhere. The FRA will need to show that it is feasible to raise ground levels for development to proceed (noting the significant flood depths) without increasing flood risk elsewhere and include an emergency access plan demonstrating safe access.

Site 10: Recommendation: Consider site layout and design

Currently the site is not located within a Flood Zone and is not impacted under climate change and would be considered suitable for development subject to a site specific Flood Risk Assessment. It is noted however that the site is subject to inundation (Depths locally 0.9-1.2m) under the climate change scenario. Given that there are areas outside of the zone of significant flood depth it may be possible to design the site layout to avoid the areas of most significant risk, in combination with land raising across the site

Site 11: Recommendation: Site-specific FRA required

Currently the site is not located within a Flood Zone and is not impacted under climate change and therefore would be considered suitable for development subject to a site specific Flood Risk Assessment.

Overall Recommendation:

Council development aspirations for the site have a range of vulnerability classifications. These include Less Vulnerable and Water Compatible development which would not require Exceptions Testing.

Owing to the port and riverside activities there are also opportunities for Essential Infrastructure in the form of 'storage of hazardous substances awaiting import or export' and 'energy generation plants and infrastructure that are reliant on a

port/riverside location' (the former originally being Highly Vulnerable but re-classified as Essential Infrastructure owing to the necessity for a riverside location).

The Council have confirm that specific development opportunities are yet to be confirmed. However, any Essential Infrastructure within Flood Zone 3a, which is 46.66% of the allocated land, would require Exceptions Testing. The outcomes of the Level 2 SFRA for this site indicate that flood risk and Exceptions Testing would be passed on the basis of ground raising within the tidally influenced area. The viability of land raising or alternative appropriate flood defences measures will need to be defined by the Site Specific FRA as and when development proposals are forthcoming.

Following further consideration, the Council intends to include the following wording within the Local Plan (to be inserted between points 4 and 5 of policy EG4 see [<https://www.stockton.gov.uk/media/875716/1-local-plan.pdf>]):

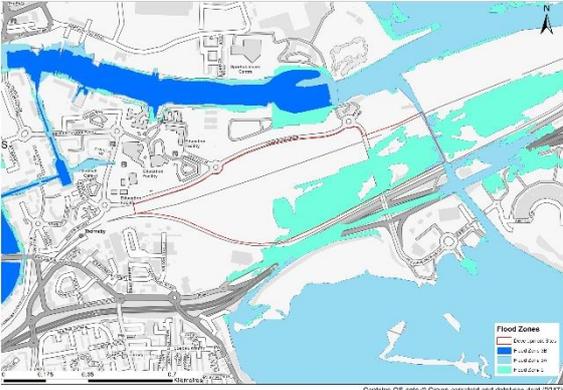
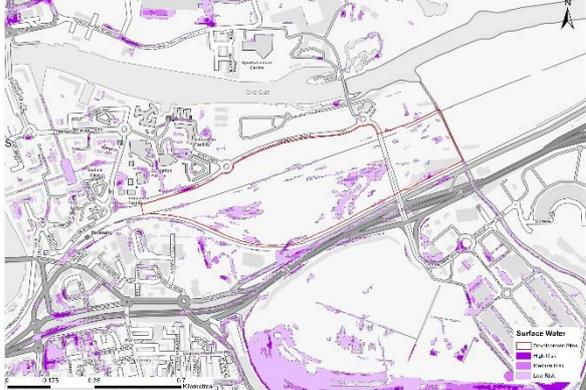
"Development at Billingham Riverside, other than water-compatible development (See National Planning Practice Guidance flood risk vulnerability classification), within areas of higher flood risk may be acceptable subject to mitigation and a site specific FRA to confirm that the level of flood risk is acceptable over the lifetime of the development. Development proposals for Essential Infrastructure (See National Planning Practice Guidance flood risk vulnerability classification), should be directed to allocated land within Billingham Riverside with the lowest flood risk in the first instance, unless there are specific requirements to develop an alternative site at Billingham Riverside."

The allocation is identified as a range of Water Compatible, Less Vulnerable and Essential Infrastructure and is located adjacent to the River Tees.

- Emerging Local Plan policy directs port and river based uses to this location. Alternative employment uses may be acceptable where policy requirements are met. Where development is proposed within areas of higher risk they may be acceptable subject to land raising and a site specific FRA to confirm that the level of flood risk is acceptable for each individual site over the lifetime of the development and does not increase flood risk elsewhere. Managing this flood risk will be dependent on the feasibility of achieving required land raising which may result in a reduction in available flood storage. However in this instance, it is noted that this is an area of predominantly tidal flood risk and land raising is unlikely to impact on tidal levels.
- Sites 6 and 11 are located in Flood Zone 1 and is, therefore, considered suitable for redevelopment subject to a site specific FRA.
- Under Climate Change conditions the area will be particularly susceptible to climate induced inundation. The majority of sites are at risk under climate change with hazard mapping in Appendix A indicating how hazard varies with topography. Flooding would be considered instantaneous and to full depth. Development should, therefore, be prioritised for lower risk areas.
- Stockton on Tees Council have identified that there are existing consents in place at Billingham Riverside for earthworks which will raise levels on part of this site. Furthermore, there are consents for land reclamation through tipping of inert construction waste to create industrial parking which is nearing completion and this work has involved major land rising. These works will have implications for Flood Zones and depths and will need to be considered within future site specific flood risk assessments.
- Surface water flooding appears generally localised and so should not impact significantly on the development potential across the majority of the sites. However localised development areas will need to consider surface water flooding and flow routes based on location.
- Published Flood mapping identifies the site is at risk from Reservoir flooding.

Site	Billingham Riverside - comprises of 11 individual sites
	<p>Developers will need to consult with the Local Planning Authority as part of the FRA as the site area is within the envelope of reservoir flooding on published flood maps.</p> <ul style="list-style-type: none">• On this basis of this assessment it is reasonable to conclude that the Part 2 of the exception test can be passed and the sites are suitable for allocation.

2.4 Tees Marshalling Yards

Site		Tees Marshalling Yards	
<p>This assessment of flood risk at Tees Marshalling Yard is provided for information only within this Level 2 SFRA as Exceptions Testing is not required based on the proposed development vulnerability classification and no development of this type being located within Flood Zone 3a.</p>			
Site area	34.49Ha		
Existing use	Brownfield		
Proposed use	Residential		
Proposed development flood risk vulnerability classification	More Vulnerable		
Proposed development impermeable area	75% of total area 25.86Ha		
Flood outlines (current day)			
			
<p>Contains OS data © Crown copyright and database right (2017) Contains public sector information licensed under the Open Government Licence v3.0. Contains Environment Agency information © Environment Agency and/or database right.</p>			
Flood Source: Tidal			
Flood Zones (%)	Flood Zone 2 0.1% AEP	Flood Zone 3a 0.5% AEP	Flood Zone 3b
	31.62	0.83	0.00
Flood Depth (m)	Max: >1.2m Mean: 0-0.15	Max: >1.2m Localised Mean: -	Max: - Mean: -
Flood Zone hazard Across	Max: Extreme	Max: Extreme	Max: - Mean: -
<p>The development site is located adjacent to the Canal & River Trust operated River Tees Barrage which is designed to retain upstream water levels and also provides additional protection to upstream areas from tidal inundation. The undefended Flood Zones indicates that the site is inundated from the Old Tees watercourse which converges with the Tees approximately 250m downstream of the site. It is noted that whilst similar, the provided modelled flood extents (2007 model) and published flood zones are not identical (currently EA flood outlines have been used). The area is also within the boundary of the Tidal Tees Integrated flood model 2011 however this does not indicate flooding to the site in the current day scenario. Climate change impacts have been considered as follows</p>			

Site	Tees Marshalling Yards
Climate change	<p>The site has been checked against the potential flood risk to the site from both fluvial (River Tees upstream of Tees Barrage) and tidal flooding (River Tees and Old River Tees downstream of Tees Barrage).</p> <p><i>Fluvial Flood Risk</i></p> <p>The existing River Tees fluvial model has been used to assess the impact of fluvial climate change on the site. The Northumbria River Basin District peak flow climate change allowances (50%-Upper End and 25% Higher Central) have been applied to provide revised flood outlines for the 2070-2115 (Epoch 3) period. The modelling indicates that the site will remain outside of the area impacted by fluvial flood risk under both the 1% and 0.1% AEP flood events. The flood outline does locally meet a small section of the site boundary to the western end of Princeton Drive, however it appears to be restricted from entering the site by the high embankment which runs along this section.</p> <p><i>Tidal Flood Risk</i></p> <p>Tidal Climate change impacts have been assessed by reviewing the peak sea level, increasing it by the North East regional allowance for each epoch as identified in Table 3 of the GOV.UK Flood Risk Assessments: Climate Change Allowances guidance up to 2115.</p> <p>32% of the total site area is currently located with Flood Zone 2 and 3a. Modelling indicates under climate change the extents of both Flood Zone 2 and 3a will extend to cover the majority of the site, particularly to the south of the main rail line. The climate change flood extents are indicated in Appendix A. The flood zones outlines are relatively similar.</p> <p>Flood depths will vary across the site areas with mean flood depths increasing from 0.6m to 0.9m (0.5% AEP) and in excess of 1.2m (0.1% AEP) across this area. Maximum flood depths under the 0.5% AEP will exceed 1.2m. The hazard rating will be significant across the site under both the 0.5% AEP and 0.1% AEP climate change events, with localised areas with an extreme hazard.</p>
Historic flooding	<p>The extreme eastern edge of the site area is contained within the Environment Agency Historic flood outline, indicating a narrow strip of flooding from the Old River Tees. This outline appears to coincide with the published Flood Zone 3a outline.</p>
Defended	<p>The site is not identified to be located within an Environment Agency Area Benefitting from Defence with no defences indicated along either the Tees or Old Tees frontages.</p> <p>The Canal and Rivers Trust River Tees barrage is located directly north of the site and is understood to provide additional levels of protection from tidal inundation to upstream areas.</p> <p>Whilst there does not appear to be formal defences, a high embankment fronts the northern (River Tees) perimeter of the existing rail marshalling yard adjacent to Princeton Drive. The geotechnical suitability of this embankment is not known.</p> <p>The heavily modified Old River Tees at the western end of the site does not appear to be defended.</p>
Flood Warning Area	<p>The site is not located within a Flood Warning Area.</p>
Flood risk	<p>The site area is an existing rail marshalling yard and is extensively covered by multiple rail tracks running from west to east which originally provided access to a large train maintenance building (now appears to have been removed).</p> <p>A high embankment extends along the northern site boundary, adjacent to</p>

Site		Tees Marshalling Yards		
	<p>Princeton Drive, with ground levels at the highest point of approximately 18.5mOD. This reduces to around 13.5mOD at the eastern end and 8.5mOD at the western end. To the south of this embankment, ground levels fall more gradually in a southerly direction from around 5mOD to 3.5mOD</p> <p>The Site is at greatest risk of flooding from the east where it adjoins the Old River Tees. In this area, the river is tidally dominated. In the current day undefended scenario approximately 46% of the site is at risk of tidal flooding and located in Flood Zone 2 (0.1% AEP). The does not generally appear to be impacted under the 0.5% tidal flood extent, with the exception of a localised strip adjacent to the Old River Tees. In addition there also appears to be a risk of very localised flooding to the south of the site where floodwater emanating from the Old Tees flooding upstream of the site follows an overland flow route and marginally enters the site via a roadway beneath the rail line. The site does not appear to be impacted as a consequence of fluvial or tidal flooding directly from the River Tees.</p> <p>The site is located adjacent to the Old River Tees so flooding would be considered to be relatively rapid.</p>			
Mitigation options & site suitability	<ul style="list-style-type: none"> • Whilst the development classification is More Vulnerable, it is likely that development of this type in the very localised areas of Flood Zone 3a can be avoided. If this approach is applied the site will not require an Exception Test. • However due to the level of current and future flood risk across this site a more detailed FRA will be required to reflect the site-specific development proposals and demonstrate that flood risk can be effectively managed over the lifetime of the development without increasing risk elsewhere. • Current day flood depths and associated hazards in areas covered by Flood Zone 2 are relatively low (0.15-0.3m and Moderate on average) however these depths and hazards will increase with climate change (depths in excess of 1.2m) and extend across a much larger proportion of the site. Managing this flood risk is likely to be difficult and require land raising which may result in a reduction in available flood storage. However in this instance, it is noted that this is an area of predominantly tidal flood risk and land raising is unlikely to impact on tide levels. • Access (including emergency access) across the site will need to take account of future flood levels. The Princeton Drive to the north of the area appears to provide suitable access. 			
Flood Source: Ground Water				
Flood risk: ground water	The site is identified to be at no risk from ground water flooding.			
Flood Source: Infrastructure Failure – Reservoirs				
Flood risk: Reservoir	The Site is generally outside the Environment published flood extent of reservoir failure. The extent appears to be contained outside of Princetown Drive to the north with only a very localised ingress to the extreme west of the site (flood depth less than 0.3m).			
Flood Source: Infrastructure Failure – Canals				
Flood risk: canal	There is a length of canalised watercourse/dock area located to the north west of the site. However, this section of watercourse does not appear to be raised above surrounding ground levels and therefore no flood risk to the site is identified.			
Flood Source: Surface Water				
Surface Water Flood Risk to Proposed Development Site Note:				
Existing development:	High Risk	Medium Risk	Low Risk	

Site			
Tees Marshalling Yards			
risk of flooding from surface water (%)	(3.33% AEP outline)	(1% AEP outline)	(0.1% AEP outline)
	0.04	0.91	9.34
Surface water flooding depths	Max: 0.3-0.6 Localised Average: 0.3-0.6	Max: 0.9-1.2 Localised Average: 0.15-0.3	Max: >1.2 Localised Average: 0.15-0.3
Surface water hazards	Max: Moderate Localised Average: Low	Max: Significant Localised Average: Low	Max: Significant Localised Average: Moderate
Climate change	The current day 1 in 1000-year outline provides an indication of the likely increase in depth and extent of the more frequent events as a consequence of climate change impacts.		
Surface water: flood risk to development site	<p>There is minimal surface water flood risk to the area up to the 0.1% AEP (Low Risk) event. At this event approximately 10% of the site area is at some level of surface water flood risk with depths generally below 0.6m with the exception of a localised area to the south of the site where a roadway beneath the rail line indicates significantly greater depths. In this locality it appears that water drains onto the site from the adjacent Middlesborough Road. Surface water flooding across the remainder of the site appears to be influenced by the current rail track layout and it is likely that the drainage installed to accommodate this reduces the general risk across the area. As surface water flood extents appear to be influenced by the presence of existing above ground and drainage infrastructure these extents are likely to change if the site layout is changed.</p> <p>Mapping identifies a further potential surface water flow route onto the site from the eastern Teesside Park Drive although the validity of this is questionable as this section of roadway is on a raised bridge across the rail lines.</p> <p>Runoff from the highway and adjacent sites may impact the site and therefore this should be assessed as part of the FRA.</p> <p>Mapping does not identify overland surface water flow routes into and across the Development Area from adjacent areas.</p> <p>OS Mapping indicates ponded floodwater located near the centre of the site. Whilst discharge of these is unconfirmed if they discharge to the River Tees, this may impact the site during high river levels and therefore this should be assessed as part of the FRA.</p> <p>Surface water flooding of the surrounding highways will need to be taken into account in consideration of emergency access and egress, however mapping indicates a low flood risk to A66 and Princeton Drive and therefore off site impacts on access and egress appear manageable.</p>		
Surface water: mitigation options & site suitability	<ul style="list-style-type: none"> • Surface water flooding appears localised and so should not impact significantly on the development potential across the majority of the site. However, localised development areas will need to consider surface water based on location. The development area is generally subject to a low surface water flood hazard. However, a site specific detailed surface water assessment and drainage strategy will be required as part of any FRA, particularly in relation to the existing drainage ditches and ponded areas. Existing drainage would need to be maintained or modified in such a way to not increase surface water flood risk. The FRA will need to mitigate climate change impacts across the lifetime of the development. • Areas subject to surface water flooding should ideally be kept free from development or alternatively flows should be redirected across the site using SuDs. 		

Site		Tees Marshalling Yards				
		<ul style="list-style-type: none"> The FRA should also assess the potential for offsite surface water impacts on the proposed development. This will need to include consideration of inflows from adjacent sites. The FRA should consider discharge to the River Tees and if these discharge routes are proven, impacts on outfall capacity during high tidal / river flows will need to be assessed. Individual FRAs should consider the impacts of surface water flooding on access and egress routes both within and outside the site (including emergency routes). Surface water flooding of the surrounding highways will need to be taken into account in consideration of emergency access and egress, however mapping indicates a low flood risk to Princeton Drive and A66 and therefore off site impacts on access and egress appear manageable. 				
Surface Water Flood Risk From Proposed Development						
(for Site Area in its Entirety)						
Proposed development limiting runoff rate: Greenfield - IH124 Methodology				3.33% AEP:	239l/s	
				1% AEP:	284l/s	
Design flood event (incl climate change)	Critical storm duration Hrs	Inflow volume m ³	Outflow volume m ³	Attenuation required m ³	Time to empty (assuming no infiltration) Hrs	Total storage required: Area (Ha) and % of site area
3.33% AEP Rainfall+20%	10	15873	4303	11570	29	0.8Ha 2.2%
3.33% AEP Rainfall+40%	12	19522	5163	14359	33	0.96Ha 2.8%
1% AEP Rainfall+20%	12	22047	6137	15910 (4340m ³ of exceedance storage)	34	1.06Ha 3.1% (0.29Ha 0.84%)
1% AEP Rainfall+40%	18	28642	7745	20897 (6538m ³ of exceedance storage)	48	1.4Ha 4.0% (0.44Ha 1.26%)
Climate change	Application of the central (20%) and upper band (40%) potential change anticipated for climate change in the table above shows the estimated attenuation volumes for the 3.33% and 1% AEP rainfall events.					
Surface water: flood risk impacts from development site & mitigation	<p>In accordance with the requirements specified by Stockton on Tees Borough Council for developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1-in-1 year rainfall event and the 1-in-100 year rainfall event should be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event. For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1-in-1 year rainfall event and the 1-in-100 year rainfall event should never exceed the peak greenfield runoff rate for the same event.</p> <p>It is recognised that this site area includes areas of brownfield and specific proposals for redevelopment will need to be provided as part of any FRA. This will need to take into account the Stockton on Tees Borough Councils requirements described above. To illustrate the potential attenuation and storage for site areas the table above identifies the required storage volumes for the proposed</p>					

Site	Tees Marshalling Yards
	<p>impermeable areas of the site area if limiting greenfield equivalent run off rates are applied. These will need to be proportioned to actual development site areas within the site area to provide an indication of attenuation / storage requirements.</p> <p>Attenuation volumes are presented for the critical storm duration for the 3.33% AEP (standard drainage design) and 1% AEP (exceedance) events for climate change. To limit off site surface water flood impacts attenuation storage will be required, both for the design drainage and exceedance events.</p> <p>An FRA and appropriate drainage / attenuation strategy will be required. There are a variety of appropriate techniques which could be adopted ranging from oversized pipes or underground storage tanks to SuDS techniques and attenuation basins. As a guide to the likely land take associated with this the table presents the area of a 1.5m deep surface storage pond and the percentage of the total site area. SuDS and attenuation requirements should be considered at the master planning stage.</p>
<p>Observations and Recommendation</p>	<ul style="list-style-type: none"> • The Council support the aspiration of residential led regeneration at Tees Marshalling Yard, which will assist in boosting housing supply should development be achieved within the plan period. No specific development proposals have been identified at this stage and will be subject to future master planning. • Approximately 68% of the site is located in Flood Zone 1 and is, therefore, considered suitable for redevelopment. This area reduces significantly under climate change. • It is assumed that through site design and layout, More Vulnerable development can avoid the existing localised area located within Flood Zone 3a (<1% of site area). This would meaning that an Exception Test is not required for this site. • Whilst More Vulnerable Development is permitted within Flood Zone 2 (32% of the area) a site specific Flood Risk Assessment will be required to confirm that the flood risk can be managed to an acceptable level over the lifetime of the development without increasing flood risk elsewhere. • The depth of flooding will increase from 0.15-0.3m under current day to in excess of 1.2m under the climate change scenario. Managing this flood risk is likely to be difficult and require land raising which may result in a reduction in available flood storage. However in this instance, it is noted that this is an area of predominantly tidal flood risk and land raising is unlikely to impact significantly on tide levels. Any impacts on flow routes across the site will need to be assessed and managed. • Beneficial impacts associated with the large embankment to the northern perimeter of the site will need to be taken into account, particularly in the future climate change scenario. • The site specific FRA will be required to confirm safe development levels (taking into account climate change) and provide and emergency action plan to demonstrate safe access. • Surface water flooding appears generally localised, but is likely to be affected by existing drainage and other infrastructure associated with the rail yard workings. Localised development areas will need to consider surface water based on location and potential changes to the current arrangements associated with the development. <p>On the basis of this assessment it is considered reasonable to conclude that development will generally be safe and acceptable under current conditions. Under tidal climate change conditions flood risk may be managed to an acceptable level by land raising. Future masterplanning and site specific FRAs will need to demonstrate how specific proposals deliver a scheme which is acceptable in terms of flood risk.</p>

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