Level 2 Strategic Flood Risk Assessment Wirral Council

Addendum to final report April 2022

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Wirral Level 2 Strategic Flood Risk Assessment

Site EMP-SA5.3

Final Report

April 2022

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Revision History

Revision Ref/Date	Amendments	Issued to
V1.0 Draft September 2021	-	John Entwistle
V2.0 Draft December 2021	Council and EA comments addressed	John Entwistle
V2.0 Final February 2022		John Entwistle
V3.0 Final April 2022	Adjustment to site boundary	John Entwistle

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Purpose

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Abbreviations

AOD	Above Ordnance Datum
BGS	British Geological Survey
EA	Environment Agency
FRCC-PPG	Flood Risk and Coastal Change Planning Practice Guidance
FMfP	Flood Map for Planning
FAA	Flood Alert Area
FRA	Flood Risk Assessment
FWA	Flood Warning Area
HFM	Historic Flood Map
LIDAR	Light Detection and Radar
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
NPPF	National Planning Policy Framework
RFM	Reservoir Flood Map
RoFSW	Risk of Flooding from Surface Water
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Drainage Systems
UU	United Utilities
WFD	Water Framework Directive

EMP-SA5.3, East of Typhoo, Moreton	
Location	Leasowe
Site area (ha)	1.93
Watercourse	The Birket and Coastal
EA Model used	Birket Fender and Arrowe Brook Fluvial Model 2011 / Wirral Tidal Model 2015
Existing use	Open space/Greenfield
Existing site flood risk vulnerability classification (NPPF)	Less vulnerable
Proposed use	Employment
Proposed development flood risk vulnerability classification (NPPF)	Less vulnerable
Proposed development impermeable area (ha)	1.64
Note: there has been a nominal amendment to the northern boundary of this site alongside the road since this Level 2 SFRA was produced. However, there is no change to the overall risk and outcomes	

EMP-SA5.3, East of Typhoo, Moreton

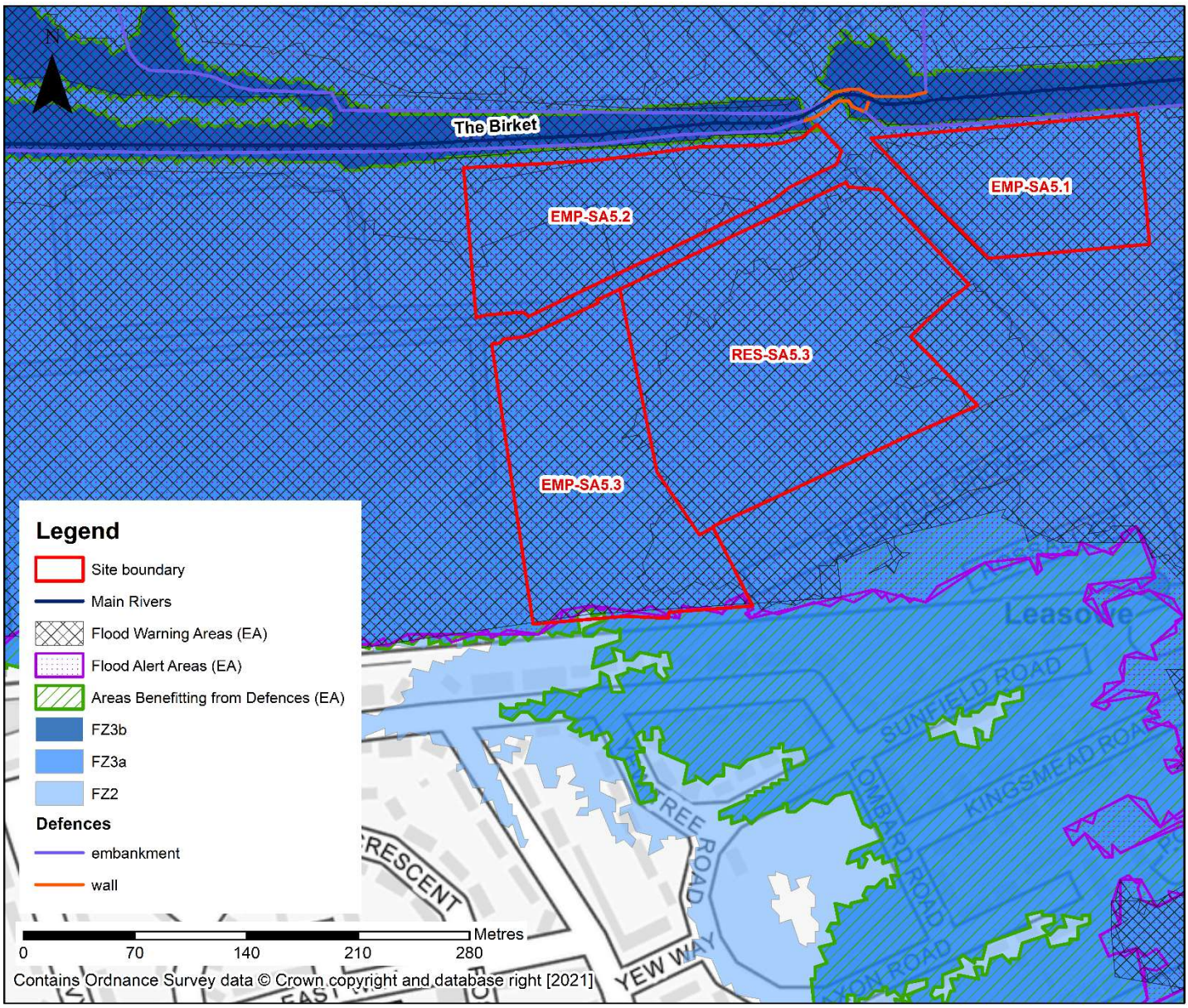


Figure 1: Existing tidal flood zones and flood risk data

The site lies within close proximity of The Birket Main River and is wholly within tidal Flood Zone 3a. Flood Zone 3b is confined to the open channel to the north of the site. There is fluvial risk to the south east of the site from The Birket. The whole site lies within the EA's 'Areas Benefitting from Defences' polygon, which shows the areas protected against tidal flooding by the Wallasey Embankment. The full extent of the site lies within a Flood Alert Area and a Flood Warning Area is in place across the southeast corner of the site. The SMP policy along the coast to the north of the site is Hold the Line.

EMP-SA5.3, East of Typhoo, Moreton

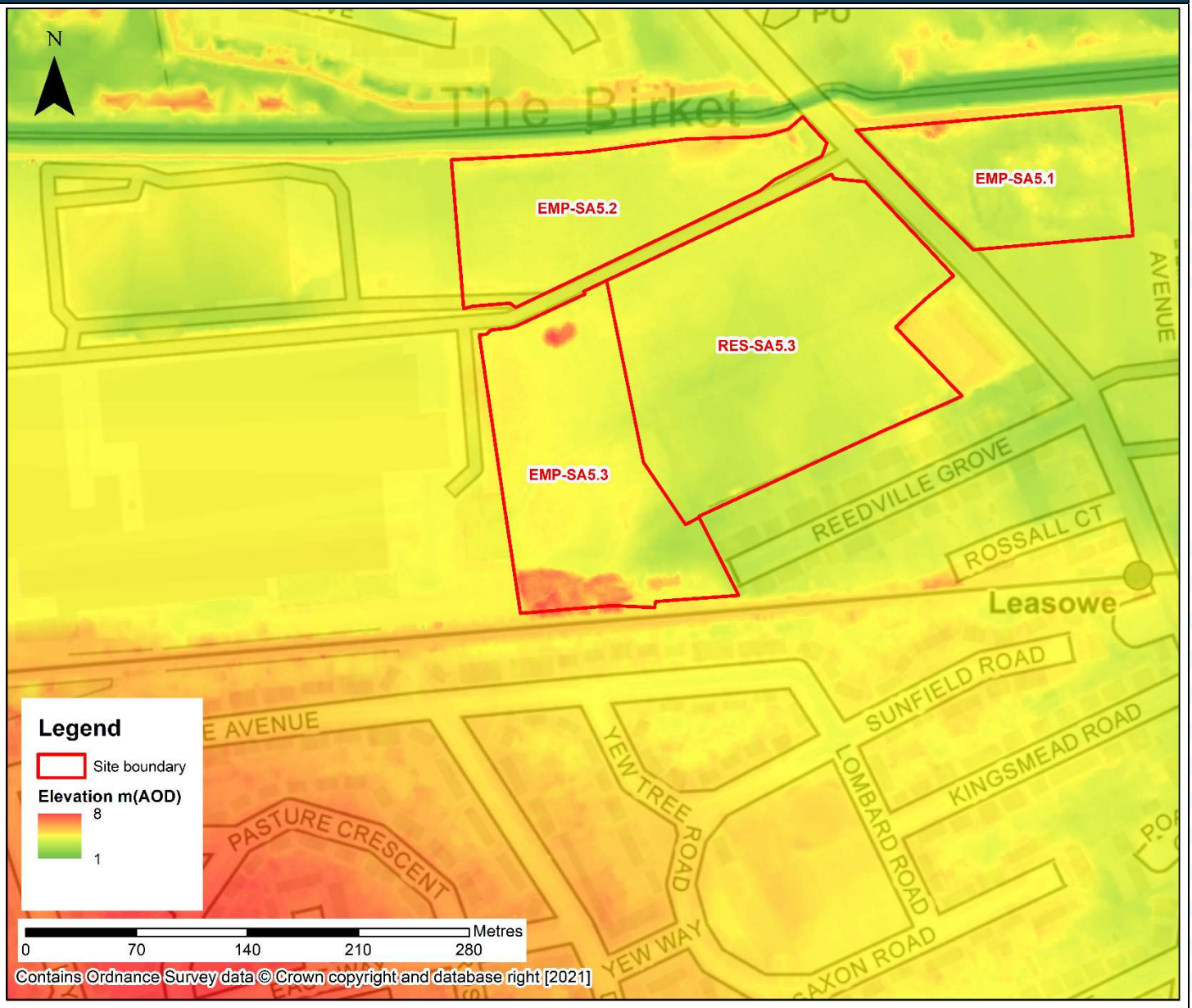


Figure 2: Topography

The elevation does not vary substantially across the site. There is an area of higher elevation towards the southwest corner of the site (6-7 mAOD) and a small raised mound at the north of the site (6.9 mAOD).

Flood Source: Tidal

Flood Zones	Flood Zone 3b	Flood Zone 3b +climate change*	Flood Zone 3a	Flood Zone 3a +climate change*	Flood Zone 2
	0%	+0%	100%	+0%	0%
Tidal: maximum depth	N/A	N/A	2.1 m	3.2 m	N/A

All figures stated based on undefended model
*Tidal climate change figures based on higher central allowance (+70% on peak flows)

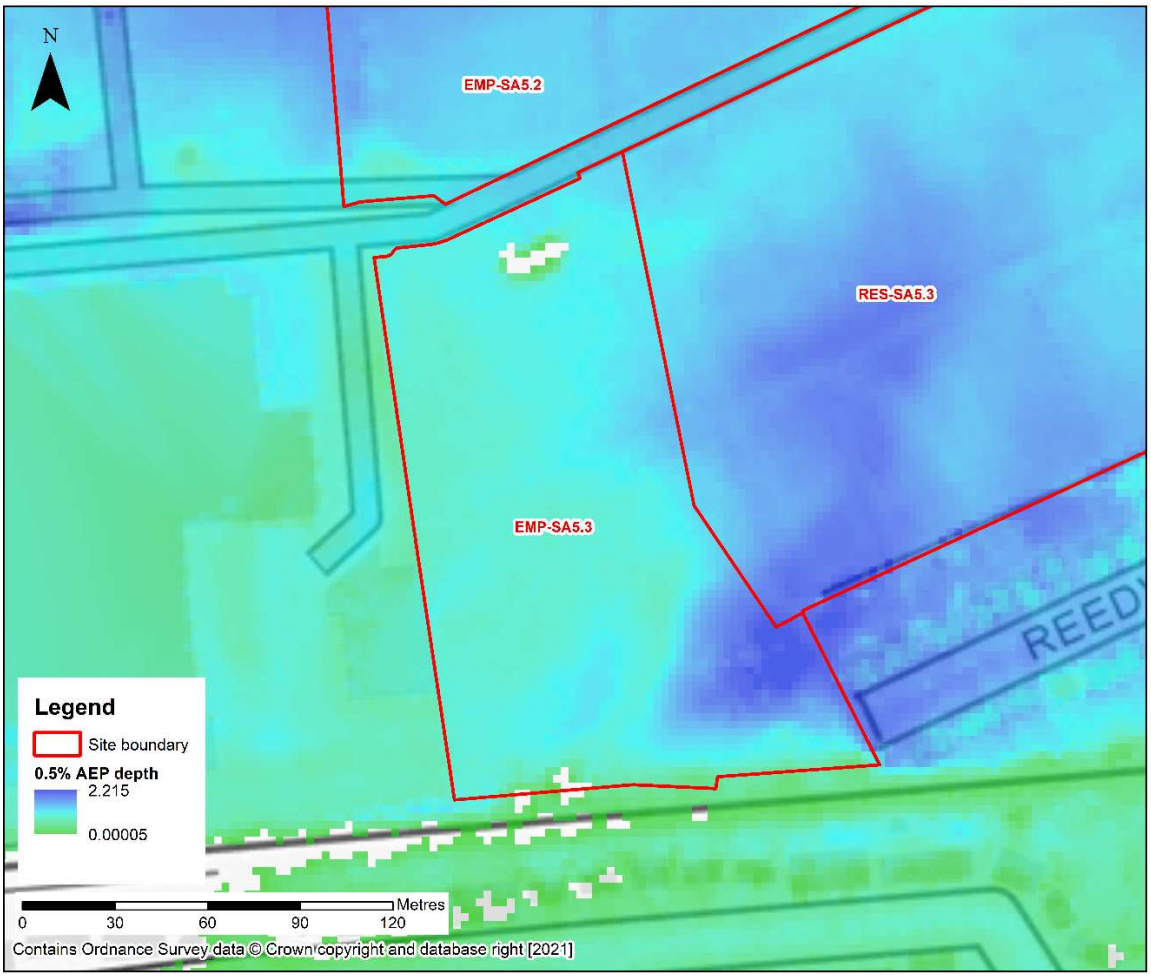
EMP-SA5.3, East of Typhoo, Moreton	
Modelled tidal risk including climate change (Wirral Tidal 2015 model)	

Figure 3: modelled tidal flood depths (m) for 0.5% AEP baseline event

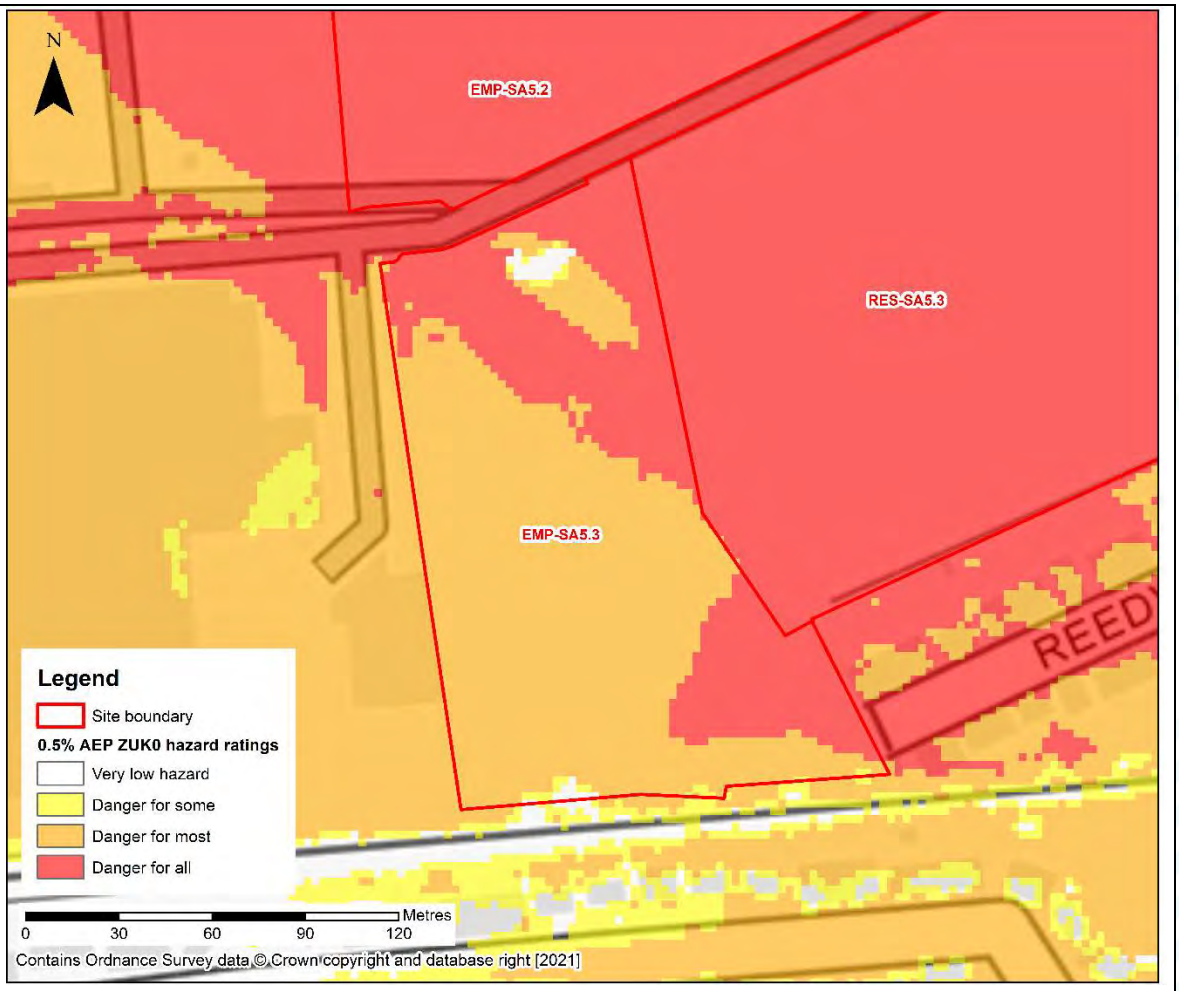


Figure 4: modelled tidal flood hazard ratings for 0.5% AEP baseline event

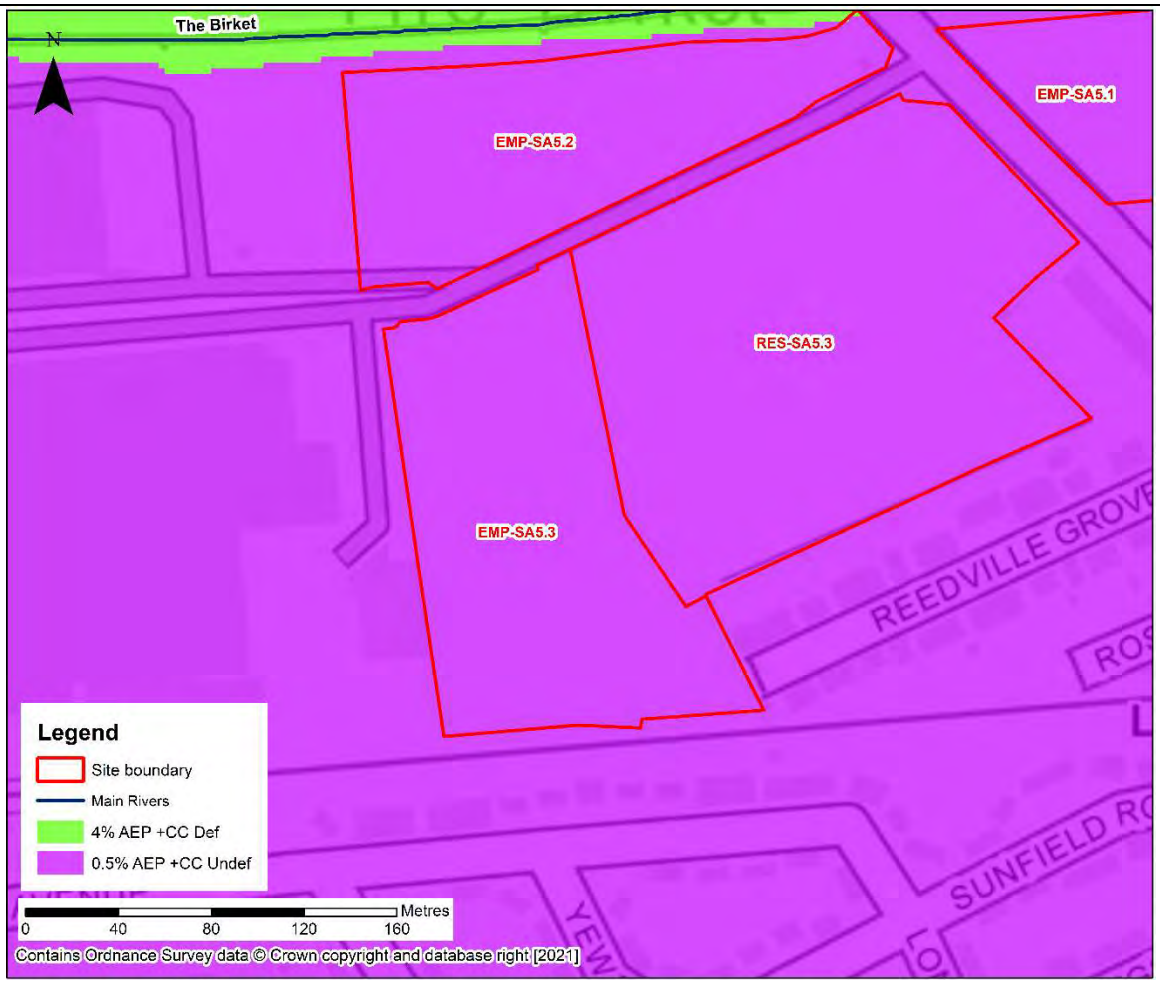


Figure 5: modelled tidal flood outlines for the higher central climate change allowance

Figure 6: modelled tidal flood depths (m) for 0.5% AEP plus climate change event

EMP-SA5.3, East of Typhoo, Moreton

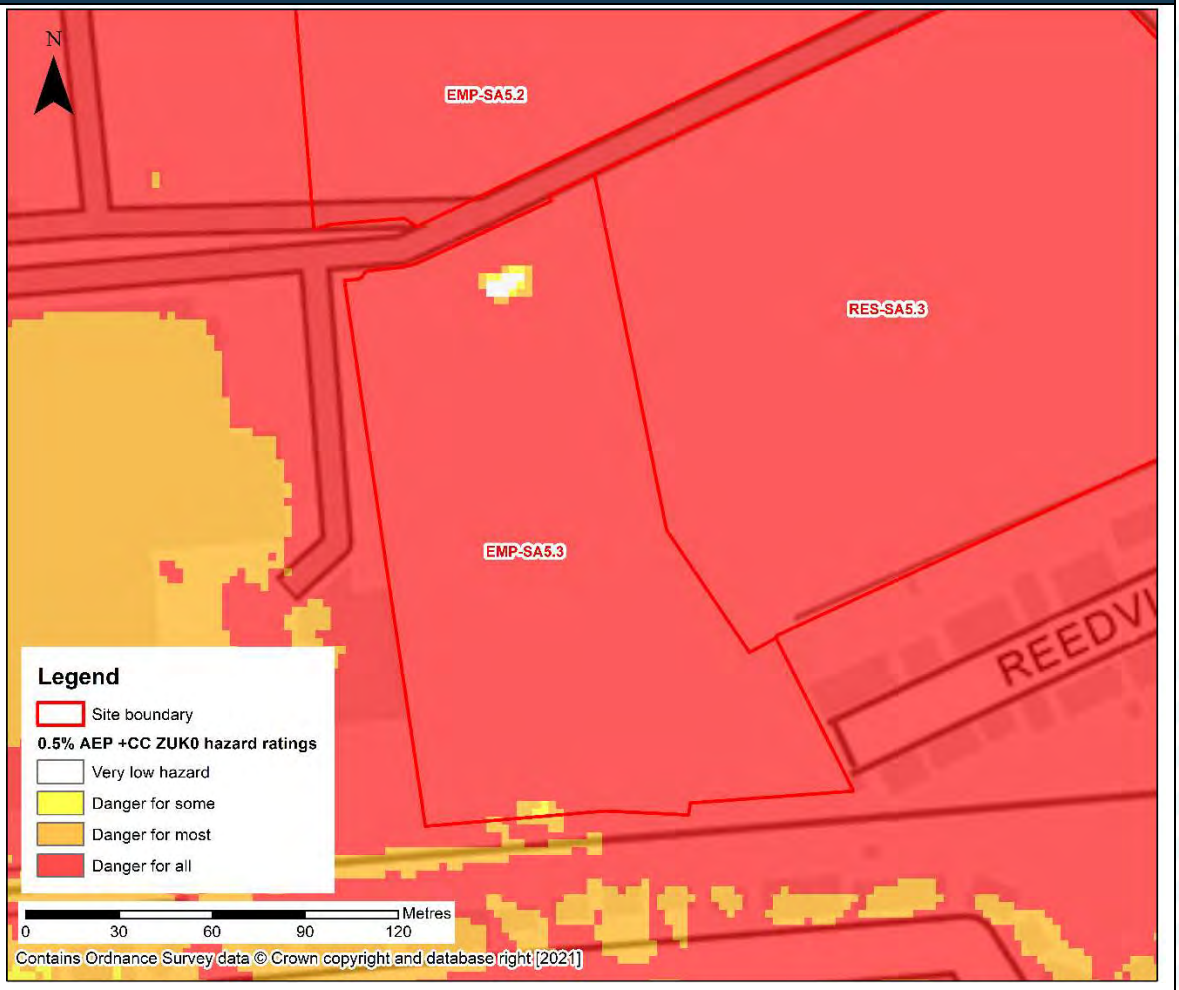
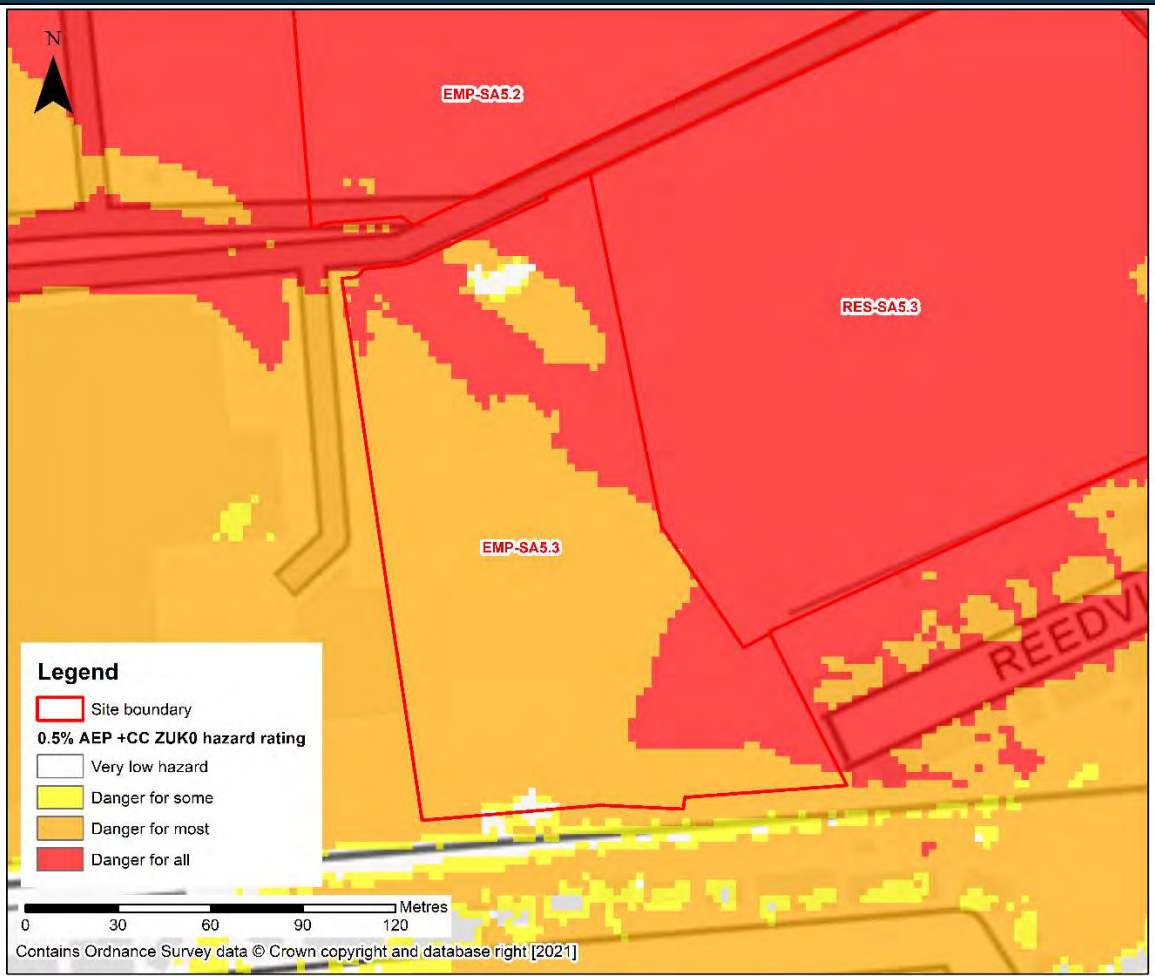


Figure 7: modelled tidal flood hazard for 0.5% AEP plus climate change event

**Tidal hazard ratings based on Table 4 of the SUPPLEMENTARY NOTE ON FLOOD HAZARD RATINGS AND THRESHOLDS FOR DEVELOPMENT PLANNING AND CONTROL PURPOSE – Clarification of the Table 13.1 of FD2320/TR2 and Figure 3.2 of FD2321/TR1. May 2008.*

The modelling shows that climate change will impact the entire site in the long term. Depths reach up to 3.2 m in the south east of the site and flood hazards across the majority of the site are 'danger for all' for the 0.5% AEP event plus climate change.

EMP-SA5.3, East of Typhoo, Moreton	
Tidal modelling: residual risk	
Breach modelling outputs on Wallasey Embankment (2021)	 **Figure 8: modelled Wallasey Embankment breach flood depths (m) for 0.5% AEP plus climate change event**

EMP-SA5.3, East of Typhoo, Moreton	
	 **Figure 9: modelled Wallasey Embankment breach flood hazards for 0.5% AEP plus climate change event** The Wallasey Embankment breach modelling outputs show that there is no risk to the site during the present-day baseline breach scenario. However, there is significant residual risk to the site during the 0.5% AEP plus climate change event. Maximum depths within the site boundary reach 2.2 m and hazards across the majority of the site range from 'danger for most' to 'danger for all'. Although the modelling outputs show significant risk in the long term, the Shoreline Management Plan strategy on this section of coastline is to hold the line. Given the large area of Wirral at risk from such a breach of the Wallasey Embankment, it is unlikely that Wirral Council would cease funding for maintenance and defence improvements into the future.
Tidal modelling: modelled land raising	
Modelled tidal risk including climate change on the coast with modelled land raising (Wirral Tidal 2018 model)	Given the significant risk exhibited at this site, both in present day conditions and when accounting for climate change, it was considered necessary to model land raising of the site as a potential mitigation technique to gauge the offsite effects of this. A simple approach was applied whereby the whole site was uplifted to a set value to ensure the whole site was raised out of the flood zone. In reality, the terrain would be gently regraded and reformed to direct displaced water to, most likely, the coast. Any FRA for the site should assess this further once site layout options are established. The elevation of the site was uplifted by 3.75 m to reflect the maximum levels for

the 0.5% + CC (higher central) event +600 mm freeboard, as recommended by the EA. The updated maximum elevation within the site boundary therefore increased to 11.33 mAOD. Figure 11 shows the entire site to be flood free when compared to the baseline 0.5% AEP +CC extent in Figure 5.

As a result of land raising, modelled depths to the west and north of the site have increased by around 40 mm when the elevation of site EMP-SA5.3 has been increased. The maximum depth within neighbouring site EMP-SA5.2 has increased by 20 mm. The maximum depth within site RES-SA5.3 has decreased by 5mm. The modelled depths to the south of the site are lower than the baseline 0.5% AEP +CC event.

Hazard ratings in the area towards the north and west of the site have increased. These areas surrounding the site were previously rated as 'Danger for most', however with the land raising applied the hazard ratings are mostly 'Danger for all'. Hazard ratings to the south of the site have improved, with more areas being classed as 'Danger for most'. Hazard ratings to the east of the site remain the same.

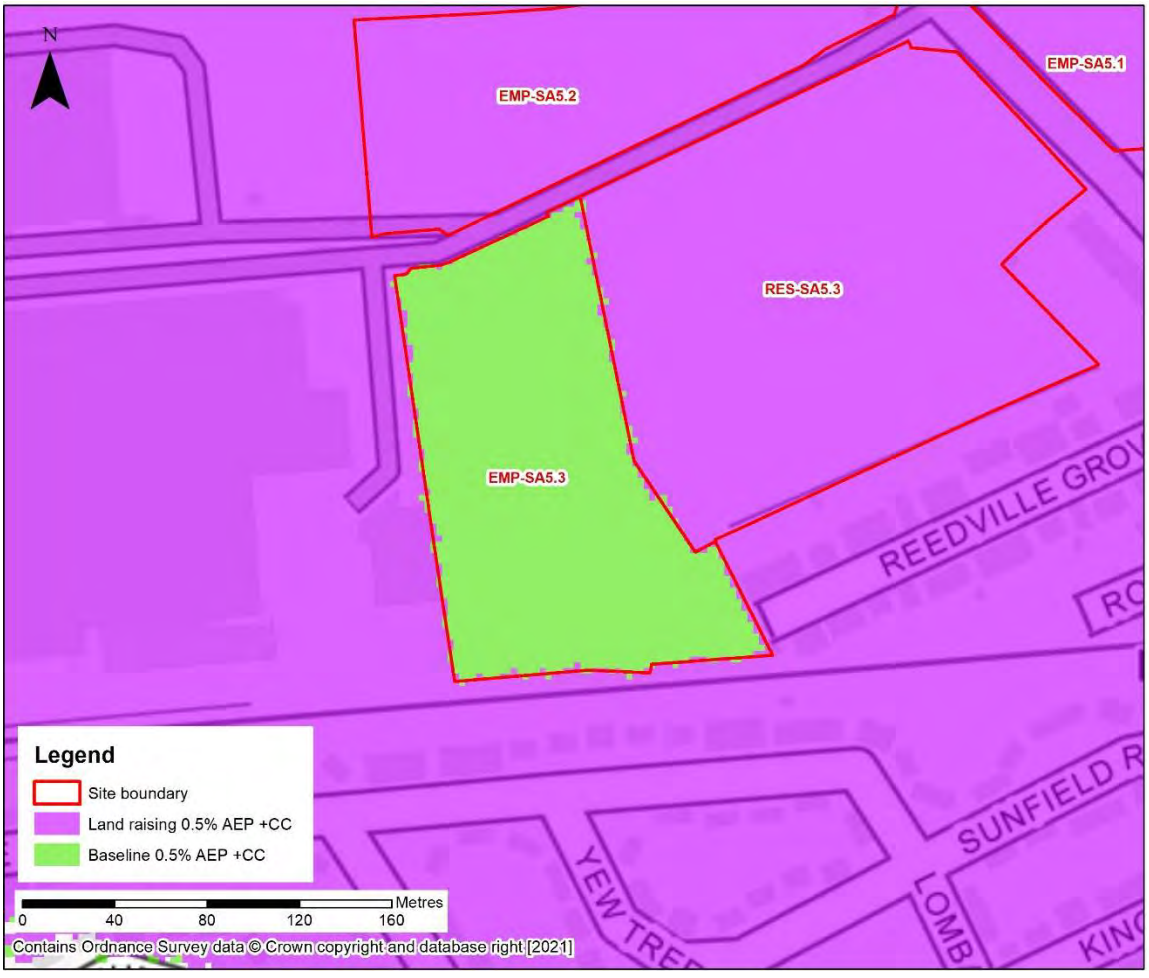


Figure 10: modelled tidal extents for the 0.5% AEP plus climate change land raising scenario

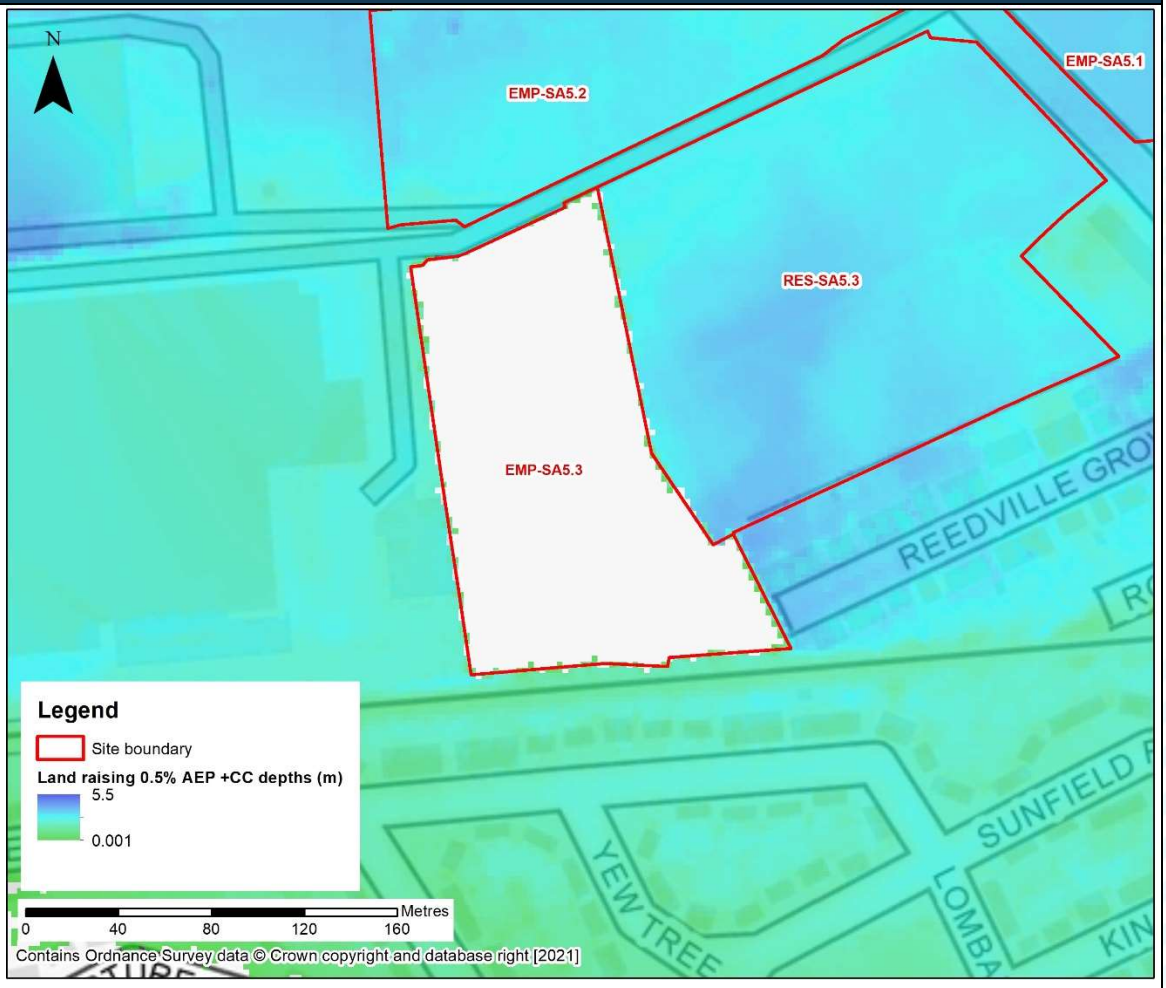
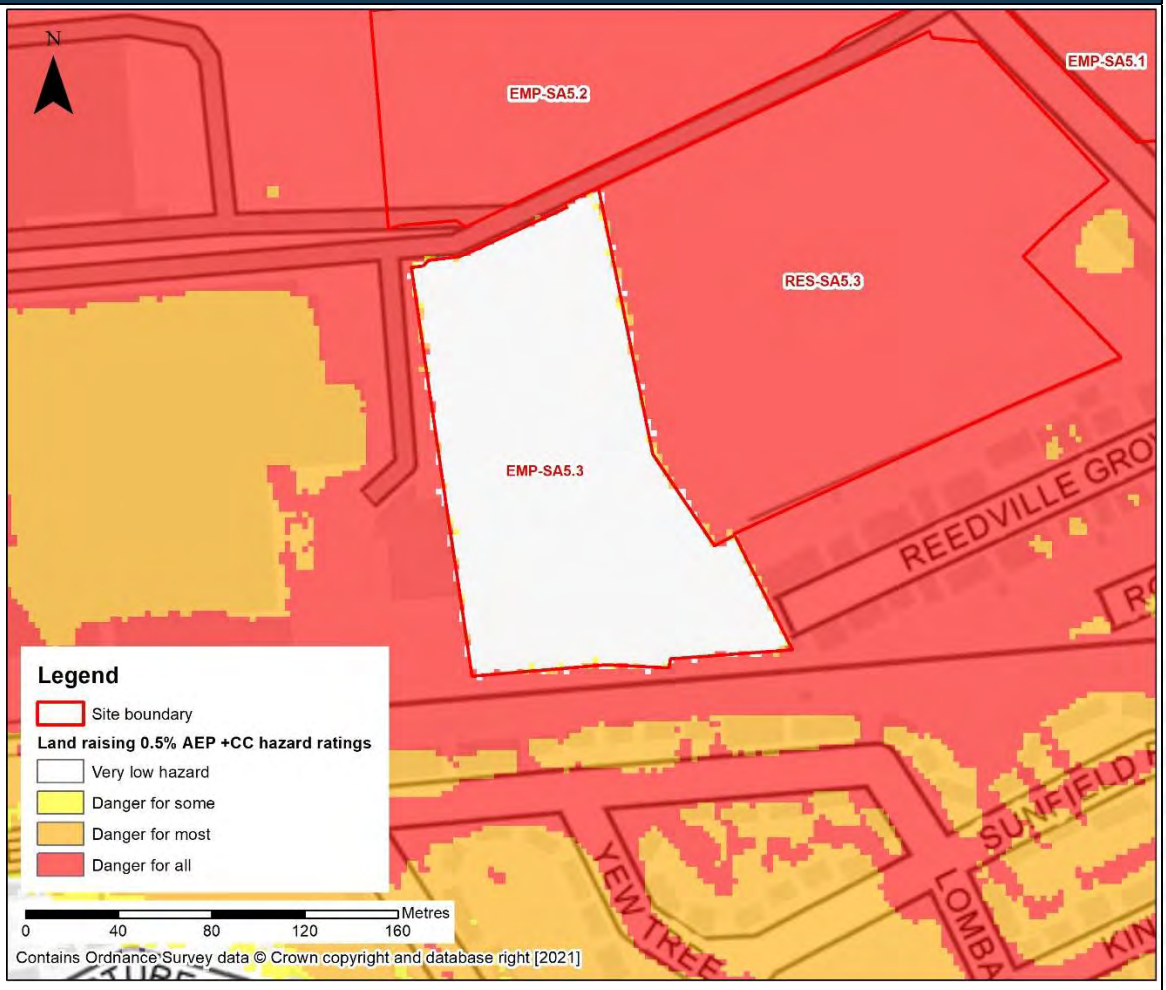
EMP-SA5.3, East of Typhoo, Moreton	
	

Figure 11: modelled tidal depths for the 0.5% AEP plus climate change land raising scenario

EMP-SA5.3, East of Typhoo, Moreton	
	 **Figure 12: modelled tidal hazards for the 0.5% AEP plus climate change land raising scenario**
Historic flooding	There is no historic flooding known to have occurred at the site.
Defences	There are five flood embankment structures and four flood wall structures within the vicinity of the site, located to the north along the banks of The Birket. It is unknown whether these defences provide any protection to the site. The whole site lies within the EA's 'Areas Benefitting from Defences' polygon, protected by the Wallasey Embankment along the north coast of the Wirral. The Wallasey embankment is a Council owned defence with a design standard of 200 and a condition grade of 2 meaning Good. The SMP policy is to Hold the Line, therefore the long-term strategy is for the defences to be adequately maintained and upgraded to maintain the status quo. It would be expected therefore that investment in these defences will continue in the long term.
Flood Warning Area	According to the EA's FWA dataset, there are two FWA in operation across the entirety of the site for the River Birket and for the Irish Sea and Mersey Estuary. These are in operation for a number of properties across Moreton and Leasowe. There are also two Flood Alert Areas in place across the site, for the Wirral catchment with Heswall, Ellesmere Port, Bebington, Hoylake and Wallasey, and the Irish Sea from New Brighton to Hoylake.

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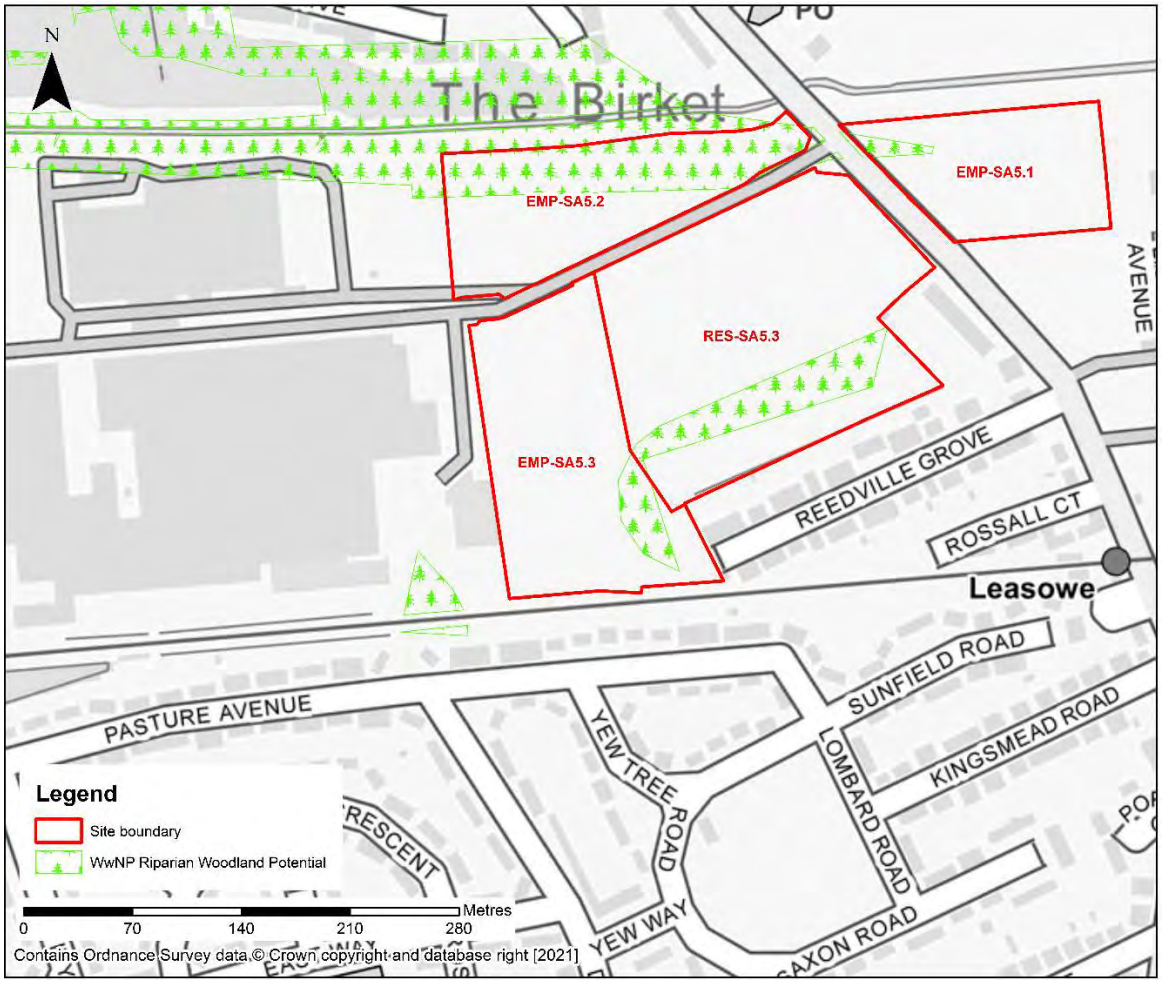
Natural Flood Management / Working with Natural Process	According to the EA's national scale 'potential for WwNP dataset', there is the potential for flood alleviation of slowing the flow through riparian woodland planting at the south-eastern boundary of the site.  **Figure 13: Areas identified as potential for riparian woodland (Working with Natural Processes)**
Observations, mitigation options & site suitability: tidal	- The whole site is within Flood Zone 3a and is at significant risk from coastal climate change. According to the Flood Map for Planning, the risk is tidal but there is also risk to the surrounding area and from The Birket which is a combination of fluvial and tidal risk. Less vulnerable uses are appropriate in Flood Zone 3a according to the NPPF, assuming appropriate resilience measures are in place. The site is also within an ABD, protected by the Wallasey Embankment from tidal flooding. - In mapping ABDs, the EA assumes that flood defences and other operating structures act perfectly and give the same level of protection as when the previous assessment of the area was made. Consultation with the LLFA on the condition and maintenance arrangements of the Wallasey Embankment should be carried out however it would be expected, given the SMP policy of 'hold the line' that investment in the defences will continue in the long term. - According to the EA's Spatial Flood Defences dataset, the defences on The Birket are in fair condition and may have defects that could reduce performance of the asset. The EA should be consulted as to the actual condition of these defences and should provide any details on possible refurbishment or replacement.

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	However, at this stage is not known whether these defences provide any protection to the site. - The site is not at residual risk from the present day 0.5% AEP breach scenario of the Wallasey Embankment but in the long term from climate change the whole site is impacted to a maximum depth of 2.2 m and hazard ratings across the site of 'danger for most' to 'danger for all'. This breach event highlights the significant risk this site and the north Wirral coastline are at from climate change. - Safe access and egress are not considered to be achievable based on the present-day Wirral Tidal model 0.5% AEP outline due to total inundation of Reedville Grove and maximum depths of around 2 m. However, the site is within an ABD and several flood warnings are in place to warn users of the development of potential flood events occurring. - Ideally this site would not be developed and would remain as open greenspace which could become multifunctional greenspace for flood storage, amenity use and to provide environmental/ecological benefits. - The modelled land raising scenario indicates raising the levels of the site to the 0.5% AEP +CC maximum level, plus 600mm freeboard, would protect the site from tidal flooding in the long term. However, raising the site above the required level of 3.75 m would represent a considerable undertaking. - The modelled depths to the north and west of the site have increased by around 40mm. Depths to the south and east have been modelled to decrease with the land raising. Depths within site EMP-SA5.2 are modelled to increase with land raising at site EMP-SA5.3. Therefore, if land raising is considered for this site then it should also mean raising EMP-SA5.2, or at least ensuring that displaced floodwater is directed appropriately away from existing and proposed development, possibly towards The Birket. - Flood protection measures, such as raised bunds, should be investigated for the western boundary of the site to protect the existing residential development to the west from increased flood depths as a result of land raising. - Modelled depths have decreased to the south and east of the site, used for residential development, indicating benefits to raising the land at the site. - Although land raising would be a viable option in protecting the site from tidal flooding, access and egress routes would still need to be available during times of flood, therefore raised escape route options should be investigated. - Stilted design may also be an option though is likely to be an expensive design solution with access and egress routes also required to be above the design flood level. - Were development of this site to proceed, given the proximity of this site to the neighbouring RES-SA5.3, EMP-SA5.2 and EMP-SA5.1, it would be prudent to formulate a strategy to develop these sites in tandem and for consultation between each developer to take place to ensure a joined-up approach for sustainable development is in place, with consideration to the strategic solutions outlined in the Level 2 SFRA Summary Report. -
Flood source: infrastructure failure – reservoirs (residual)	
Flood risk: reservoir	There is no risk of flooding to the site as a result of dam failure, according to the EA's online RFM.

EMP-SA5.3, East of Typhoo, Moreton			
Flood source: infrastructure failure – canals (residual)			
Flood risk: canal	There are no canals in the vicinity of this site.		
Flood source: surface water			
Surface Water Flood Risk to Proposed Development Site			
Current site: Risk of Flooding from Surface Water map	High Risk (3.3% AEP event)	Medium Risk (1% AEP event)	Low Risk (0.1% AEP event)
	2.8%	4.5%	8.3%
Surface water max flood depths	0.3 – 0.6m	0.3 – 0.6m	0.6 – 0.9m

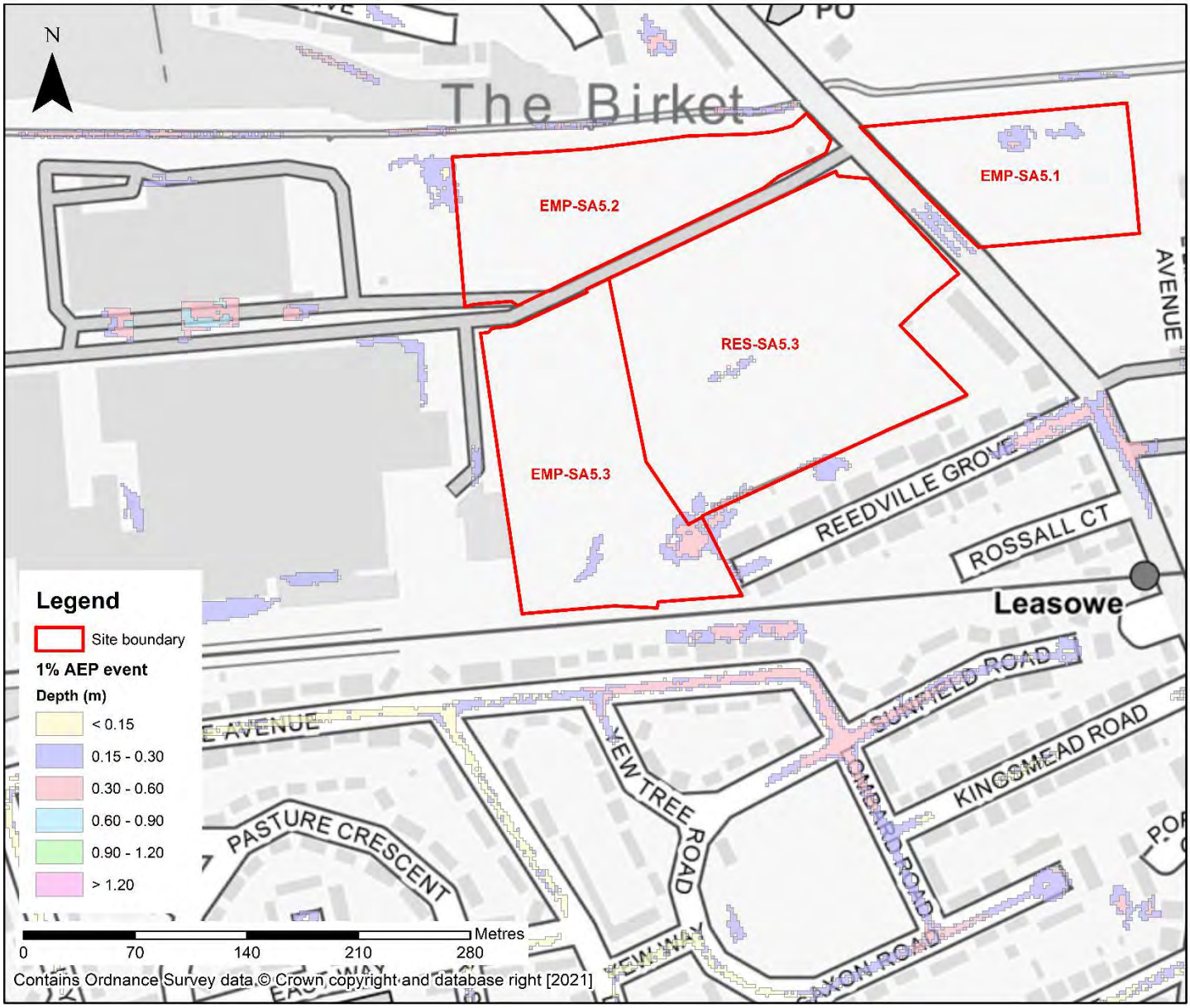

Figure 14: 1% AEP event surface water flood depths (Risk of Flooding from Surface Water map)

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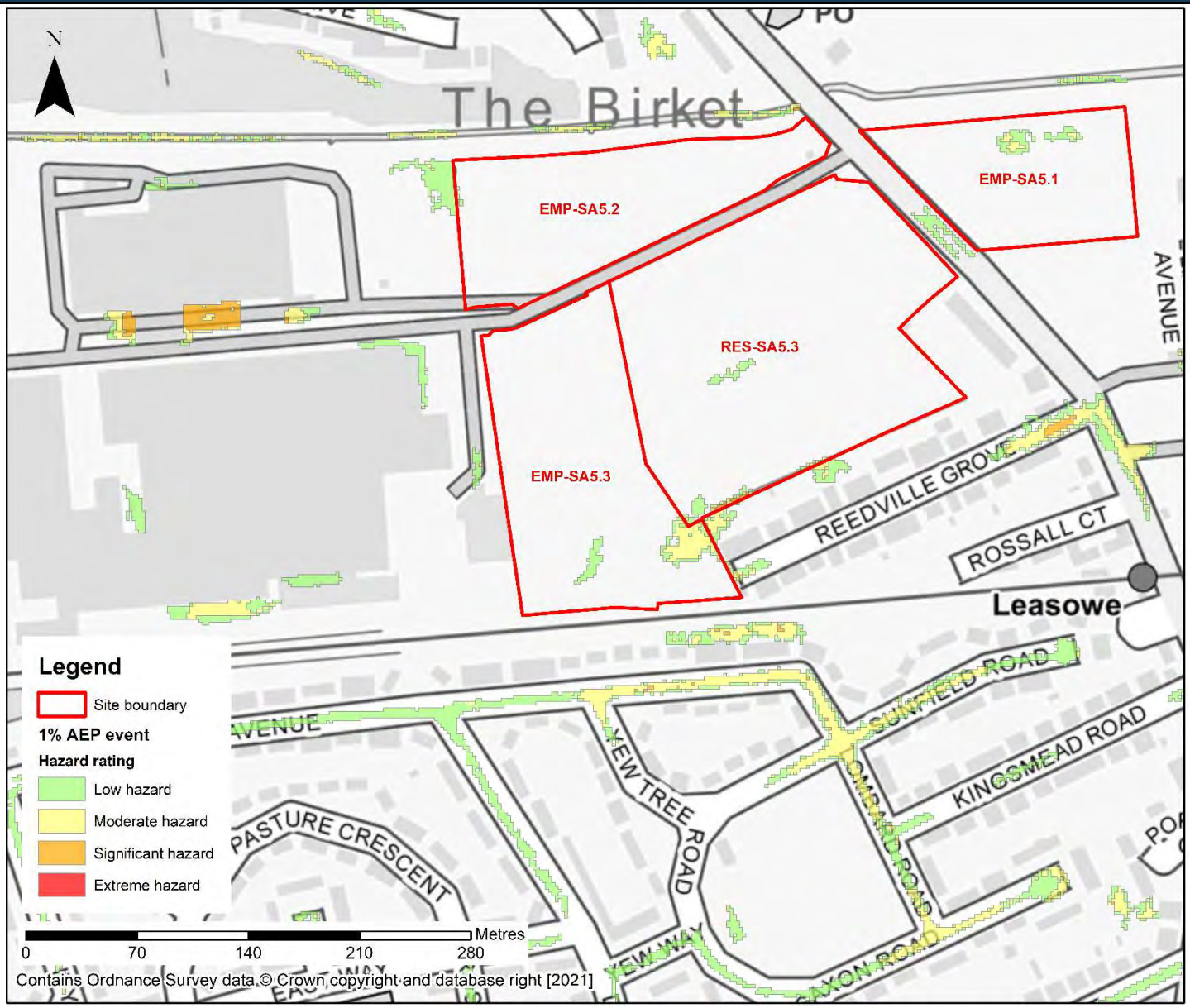


Figure 15: 1% AEP event surface water flood hazards (Risk of Flooding from Surface Water map)

**Surface water hazard rating based on Table 4.2 Hazard to People as a Function of Velocity and Depth, R&D OUTPUTS: FLOOD RISKS TO PEOPLE: PHASE 2 FD2321/TR2. Defra. March 2006.*

Surface water flood risk to development site	Approximately 5% of the site is at risk of surface water flooding in the 1% AEP event to a maximum depth greater than 0.3-0.6 m and with areas of moderate hazards. The risk is localised to the southeast corner of the site within the vicinity of Reedville Grove. Overall, the area of the site at risk of surface water flooding is low
Climate change	The current day 0.1% AEP event outline provides an indication of the likely increase in extent of the more frequent events. The 0.1% AEP event outline covers approximately 8% of the total site area and the extent is localised to the low-lying area to the south of the site. Reedville Grove becomes partially inundated with max depths ranging between 0.6 and 0.9 m, and

EMP-SA5.3, East of Typhoo, Moreton	
	hazards moderate to significant. Access may not be viable from this road during a 0.1% AEP surface water flood event. Access to the site via the minor roads to the north of the site appear to be viable, as these are not shown to be inundated during a surface water flood event.
Observations, mitigation options & site suitability: surface water	Development should avoid the 1% AEP surface water event outline. This is localised to a depression in the southern part of the site so should be avoidable. A full drainage strategy would be required to ensure there is no increase in surface water flood risk elsewhere as a result of new development. This may require surface water modelling based on proposed layout plans and consultation with the LLFA. Runoff volumes should not exceed greenfield rates. Current risk of surface water flooding is minimal however, this may change if the area of permeable ground is decreased to allow for new development.

Surface Water Flood Risk from Proposed Development

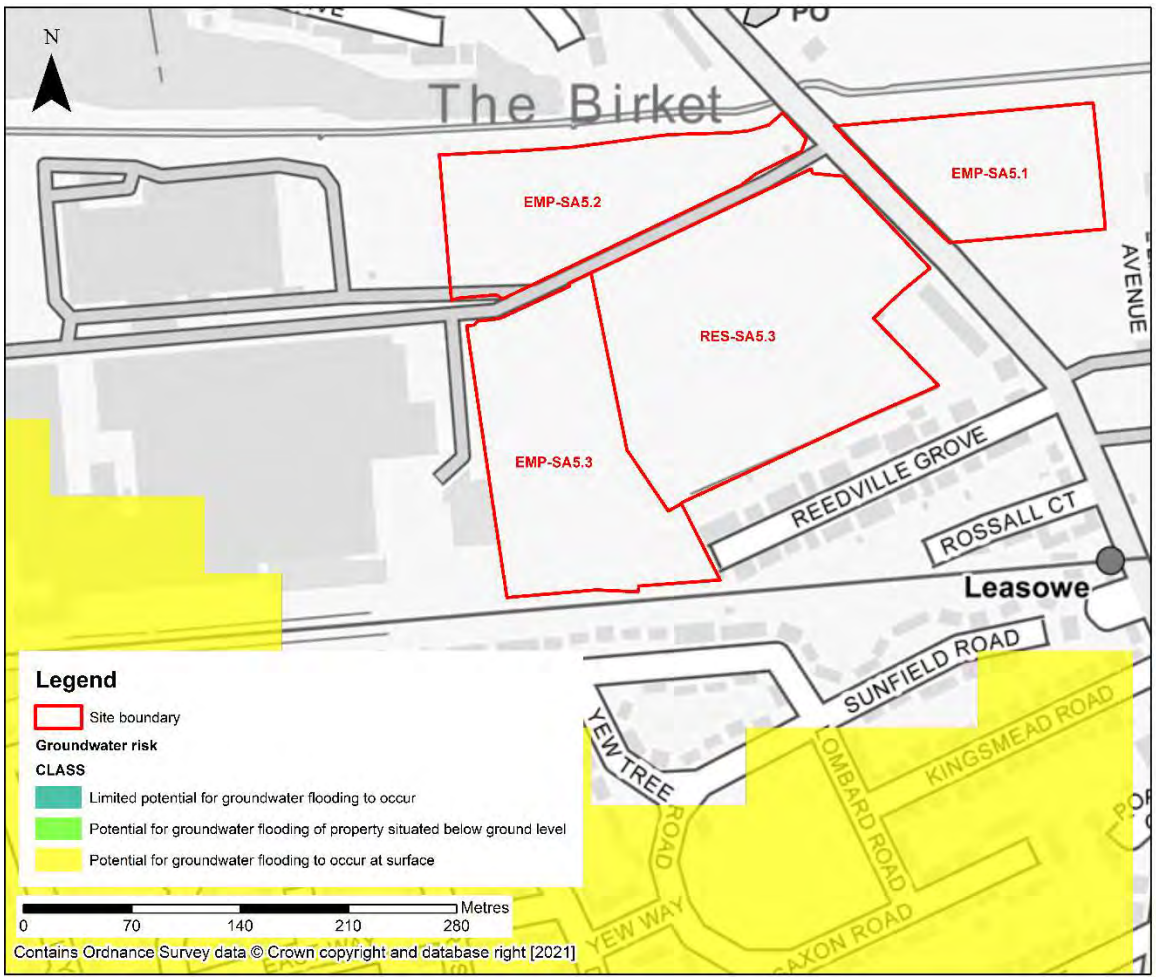
Runoff rates should not exceed current rates and if possible, betterment of existing rates should be aimed for. For the purposes of this assessment, the required volumes of attenuation have been calculated below based on an assumed 85% impermeable area and limiting greenfield runoff rate of Qbar (l/s).

Proposed development limiting runoff rate: (l/sec)
Qbar: 8.14 l/s (FEH Statistical)
Q30: 13.83 l/s
Q100: 16.92 l/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
30yr Rainfall+20%	10	1060	205	855	41.6	0.057 ha 2.953 %
30yr Rainfall+40%	12	1282	246	1036	50.3	0.069 ha 3.579 %
100yr Rainfall+20%	11.5	1446	236	1211 (356 exceedance storage)	58.8	0.081 ha 4.183 %
100yr Rainfall+40%	12*	1699	246	1453 (417 exceedance storage)	70.7	0.097 ha 5.019 %

* Limited to a 12hr critical storm

Climate change	Application of the central (+20%) and upper end (+40%) allowances for potential change anticipated for the 2080s in the table above shows the estimated attenuation volumes for the 1% AEP and 3.33% AEP rainfall events.
Surface water: flood risk impacts from development site, mitigation & SuDS	As part of this Level 2 SFRA we have included calculations to provide an estimated land take if a pond with an assumed depth of 1.5m was included as part of the development. Attenuation volumes are presented for the critical storm duration for the 3.33% AEP event with exceedance flows quantified up to the 1% event. To prevent development worsening flood risk elsewhere, surface water runoff must be managed on site.

EMP-SA5.3, East of Typhoo, Moreton	
	To prevent development increasing the surface water flood risk, surface water runoff must be managed. SuDS may be possible but would be subject to ground investigation and contaminated land assessment at the FRA stage.
Flood Source: Groundwater	
Flood risk: groundwater	 **Figure 16: Susceptibility of groundwater flooding (BGS national dataset)** Based on geological and hydrogeological information, the BGS dataset can be used to identify areas where geological conditions could enable groundwater flooding to occur and where groundwater may come close to the ground surface. The dataset should not be used on its own to make planning decisions at any scale and should not be used to inform planning decisions at the site scale. The susceptibility data cannot be used on its own to indicate risk of groundwater flooding. The dataset shows that the site is not prone to groundwater flooding.
Overall Site Assessment	
Access and egress	Based on the risk presented, safe access and egress routes would not be achievable due to the significant risk to all routes surrounding the site. The flood warning system in place should ensure site users can evacuate the site ahead of any potential flood event in the short term. However, the modelled impact from climate change is severe and safe escape routes will be difficult to achieve.

EMP-SA5.3, East of Typhoo, Moreton	
Recommendation summary	Based on the evidence presented in the Level 1 SFRA and this Level 2 SFRA: - Early discussions should take place with the EA with regards to the tidal flood risk issues on this site. The EA offers early engagement through an advisory service via their website (https://www.gov.uk/guidance/developers-get-environmental-advice-on-your-planning-proposals) or by emailing the local office: SPPlanning.RFH@environment-agency.gov.uk. - This site should not be developed and should be used as multifunctional greenspace. - However, land raising could be a viable option to protect the site from tidal flooding in the long term and should be explored at the FRA stage. - Flood protection measures, such as raised bunds, should be investigated for the western boundary of the site to protect the existing residential development to the west from increased flood depths as a result of land raising. Options to direct additional floodwater towards The Birket should be investigated. - Were development plans to proceed, given the site is wholly within an ABD protecting the site against tidal risk, the EA and/or LLFA should be consulted specifically for details on the flood defences i.e. condition, maintenance arrangements for the lifetime of the development (~70 years for employment). - Include flood resilience measures in site design. - Any consideration for development must fully investigate the options presented in this Level 2 SFRA including for the provision of safe access and egress routes at all times. - Detailed emergency plans should be produced alongside the EA's flood warnings to ensure the safe evacuation of site users in advance of a flood event occurring.
Can the second part of the Exception Test be satisfied?	Site not subject to the Exception Test though development is appropriate according to the NPPF, subject to suitable FRA including for effective mitigation against climate change.
FRA requirements	- Raised escape routes and displaced floodwater diversion options should be investigated. - The FRA should investigate land raising options in more detail and confirm whether raised bunds along the western boundary of the site would be viable. - Full consideration should be given to the impact development may have on the adjacent sites RES-SA5.3, EMP-SA5.2 and EMP-SA5.1. Planning for flood risk for each site should be carried out in tandem. - The FRA should fully assess emergency planning arrangements and should include a full Emergency Plan for the site. - Flood resilience measures should be included in the site design at an early stage of planning. - Any FRA should be carried out in line with the NPPF; FRCC-PPG; Local Plan and LLFA policies; and national and local SuDS policy and guidelines. - Throughout the FRA process, consultation should be carried out with the following, where applicable, the LPA; LLFA; emergency planning officers; EA; UU; the highways authorities; and the emergency services.

EMP-SA5.3, East of Typhoo, Moreton

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Wirral Level 2 Strategic Flood Risk Assessment

Site EMP-SA5.4

Final Report

April 2022

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Revision History

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Principal Flood Risk Analyst

Purpose

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JBA is aiming to reduce its per capita carbon emissions.

Abbreviations

AOD	Above Ordnance Datum
BGS	British Geological Survey
EA	Environment Agency
FRCC-PPG	Flood Risk and Coastal Change Planning Practice Guidance
FMfP	Flood Map for Planning
FAA	Flood Alert Area
FRA	Flood Risk Assessment
FWA	Flood Warning Area
HFM	Historic Flood Map
LIDAR	Light Detection and Radar
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
NPPF	National Planning Policy Framework
RFM	Reservoir Flood Map
RoFSW	Risk of Flooding from Surface Water
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Drainage Systems
UU	United Utilities
WFD	Water Framework Directive

EMP-SA5.4: Land at Tarran Way North, Moreton	
Location	Land at Tarran Way North, Moreton
Site area (ha)	0.25
Watercourse	The Birket and coastal
EA Model used	Wirral Tidal model 2015
Existing use	Brownfield
Existing site flood risk vulnerability classification (NPPF)	Less vulnerable
Proposed use	Employment
Proposed development flood risk vulnerability classification (NPPF)	Less vulnerable
Proposed development impermeable area (ha)	0.21
Note: there has been a nominal amendment to the northern boundary of this site alongside Tarran Way North road since this Level 2 SFRA was produced. However, there is no change to the overall risk and outcomes	

EMP-SA5.4: Land at Tarran Way North, Moreton

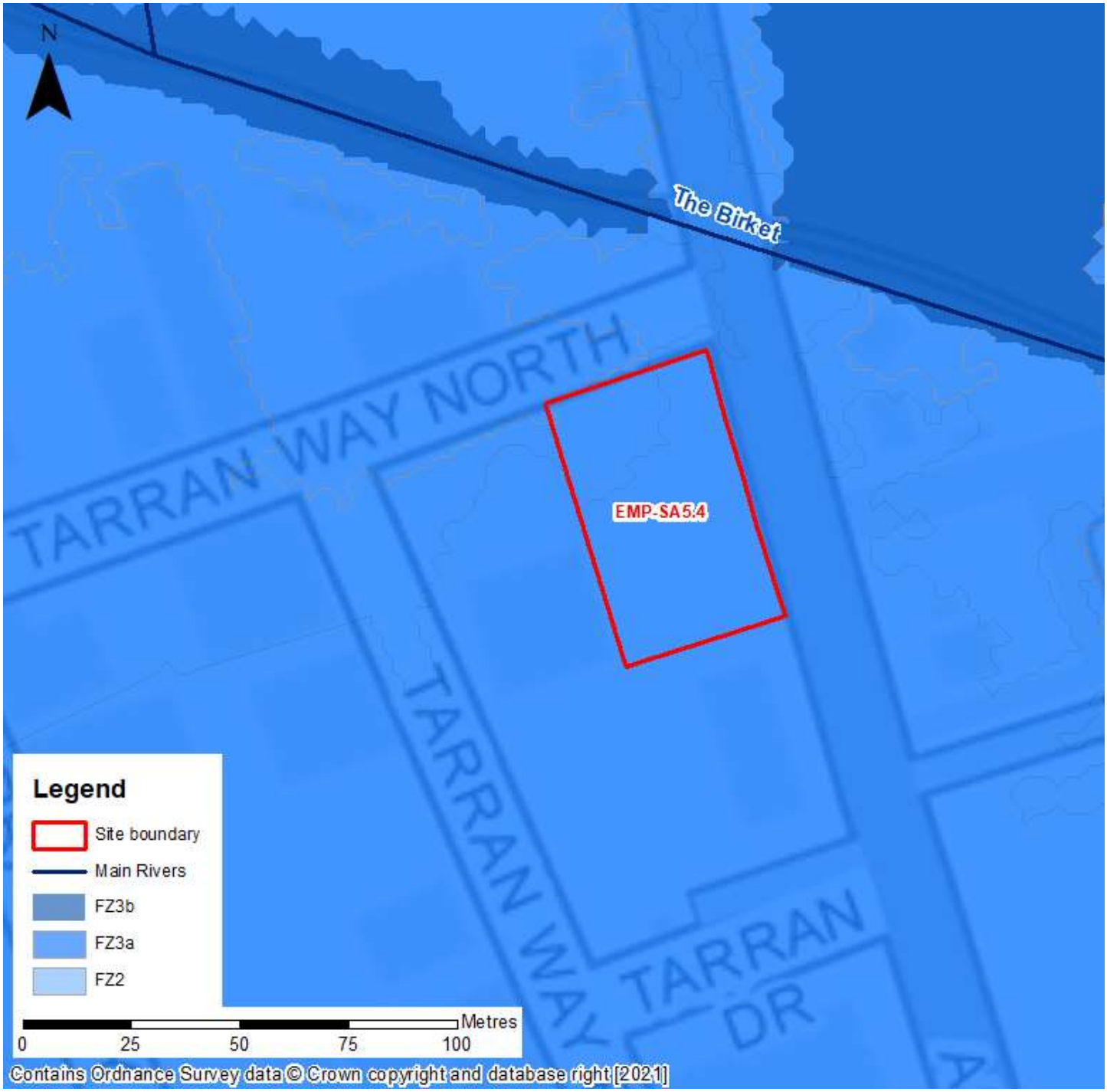


Figure 1: Existing tidal flood zones

EMP-SA5.4: Land at Tarran Way North, Moreton

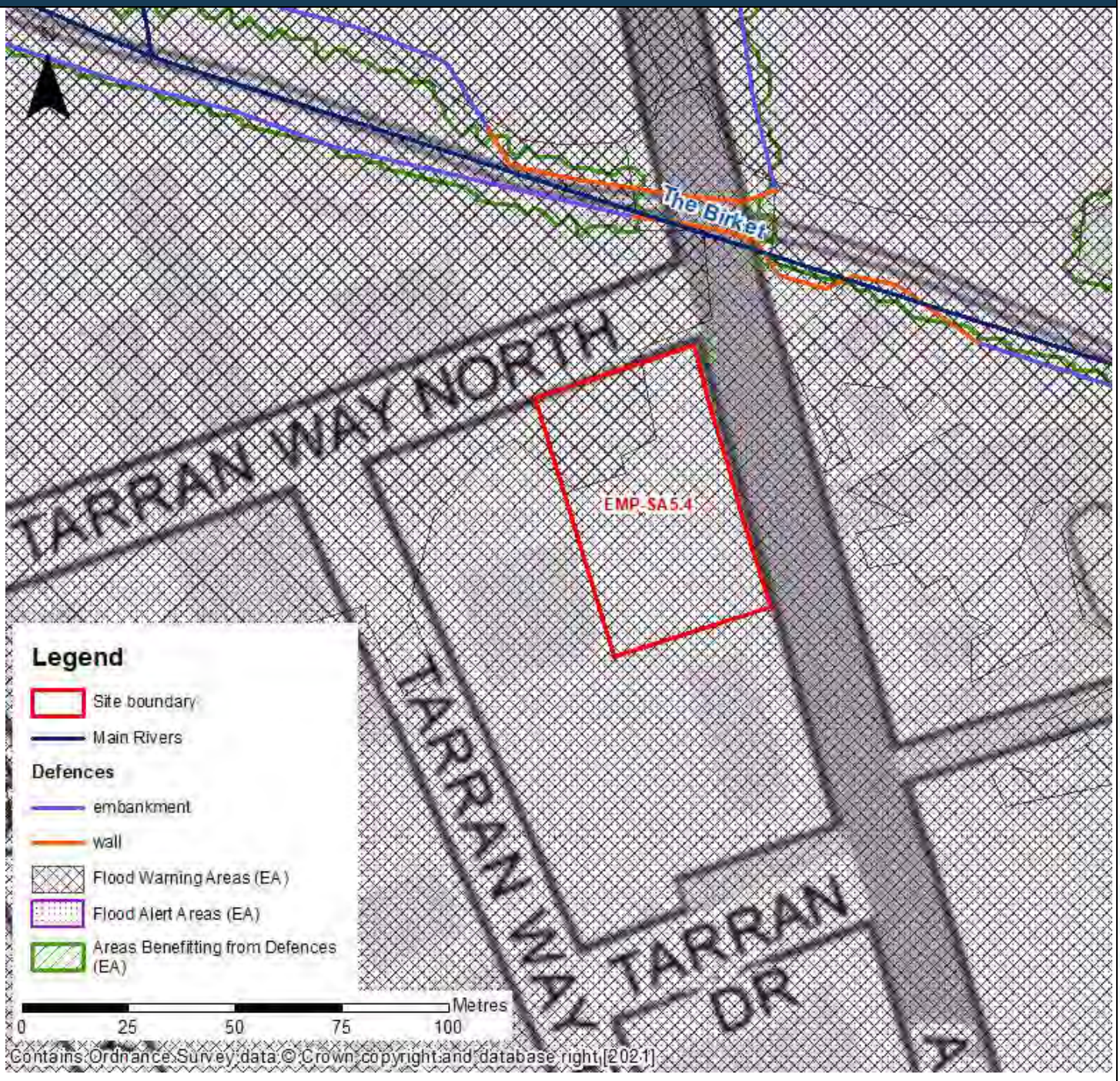


Figure 2: Existing flood risk data

The Main River The Birket flows eastwards to the north of the site and the entirety of the site lies within Flood Zone 3a which the Flood Map for Planning states is tidal risk. The site is also covered entirely by an ABD for the coastal Wallasey Embankment. The whole site is covered by a tidal FWA and two FAAs.

EMP-SA5.4: Land at Tarran Way North, Moreton

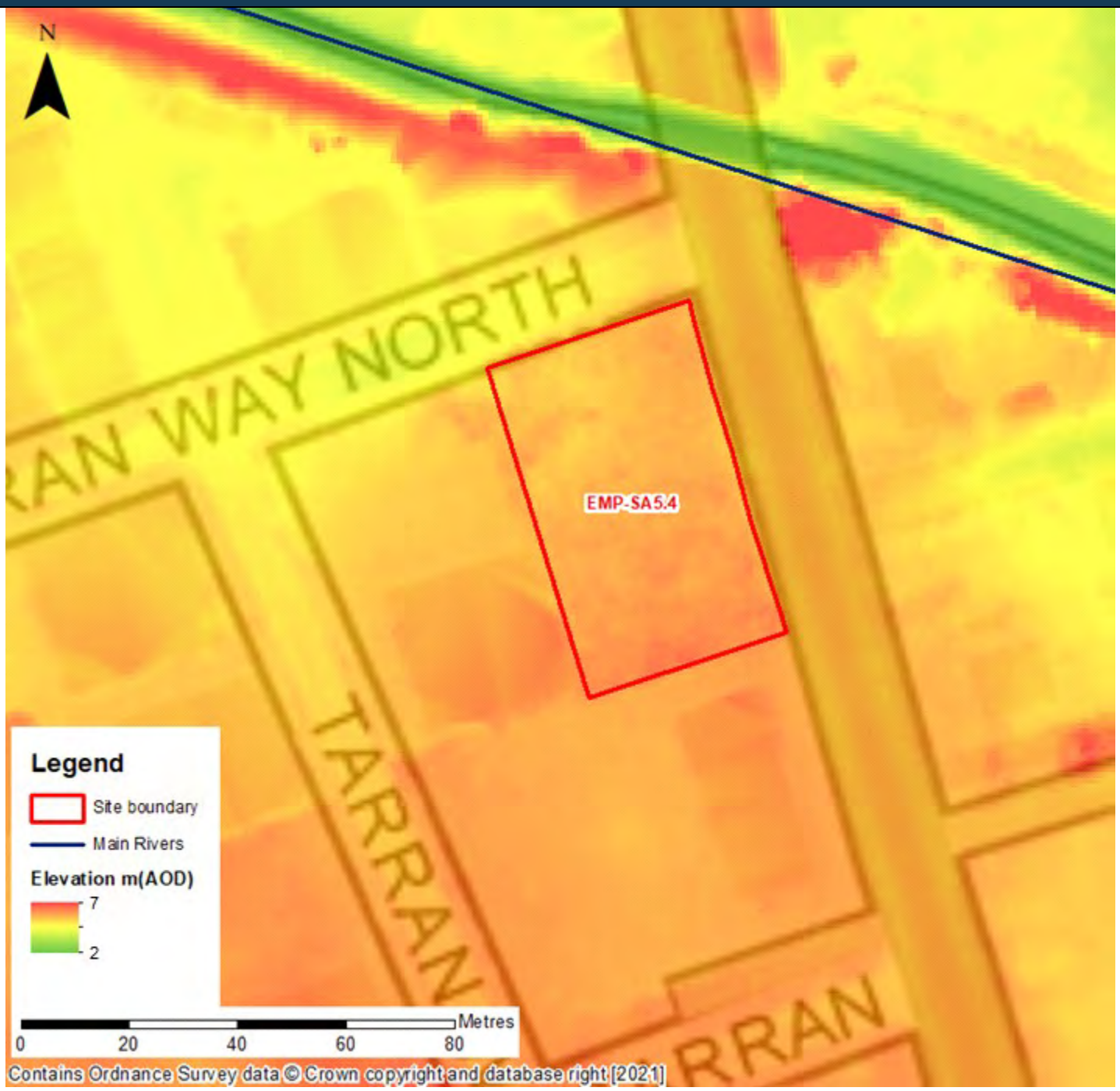


Figure 3: Topography

The elevation does not vary substantially across the site remaining consistent at between 4 and 5 m AOD. There are areas of slightly higher elevation on the right bank of the River Birket at approximately 6 m AOD. The elevation of the area surrounding the site is generally flat and consistent with that of the site

EMP-SA5.4: Land at Tarran Way North, Moreton					
Flood Source: Tidal					
Flood Zones	Flood Zone 3b	Flood Zone 3b +climate change*	Flood Zone 3a	Flood Zone 3a +climate change*	Flood Zone 2
	0%	N/A	100%	100%	0%
Tidal: maximum depth	N/A	N/A	1.9 m	2.9 m	N/A
Flood Zone 3b figures stated based on defended model; Flood Zone 3a and 2 figures stated based on undefended model *Climate change figures based on higher central allowance (70th percentile)					

Modelled tidal risk including climate change (Wirral Tidal 2015 model)

NOTE: modelled outputs for this SFRA are subtly different to original 2015 modelled outputs due to upgraded modelling and GIS software

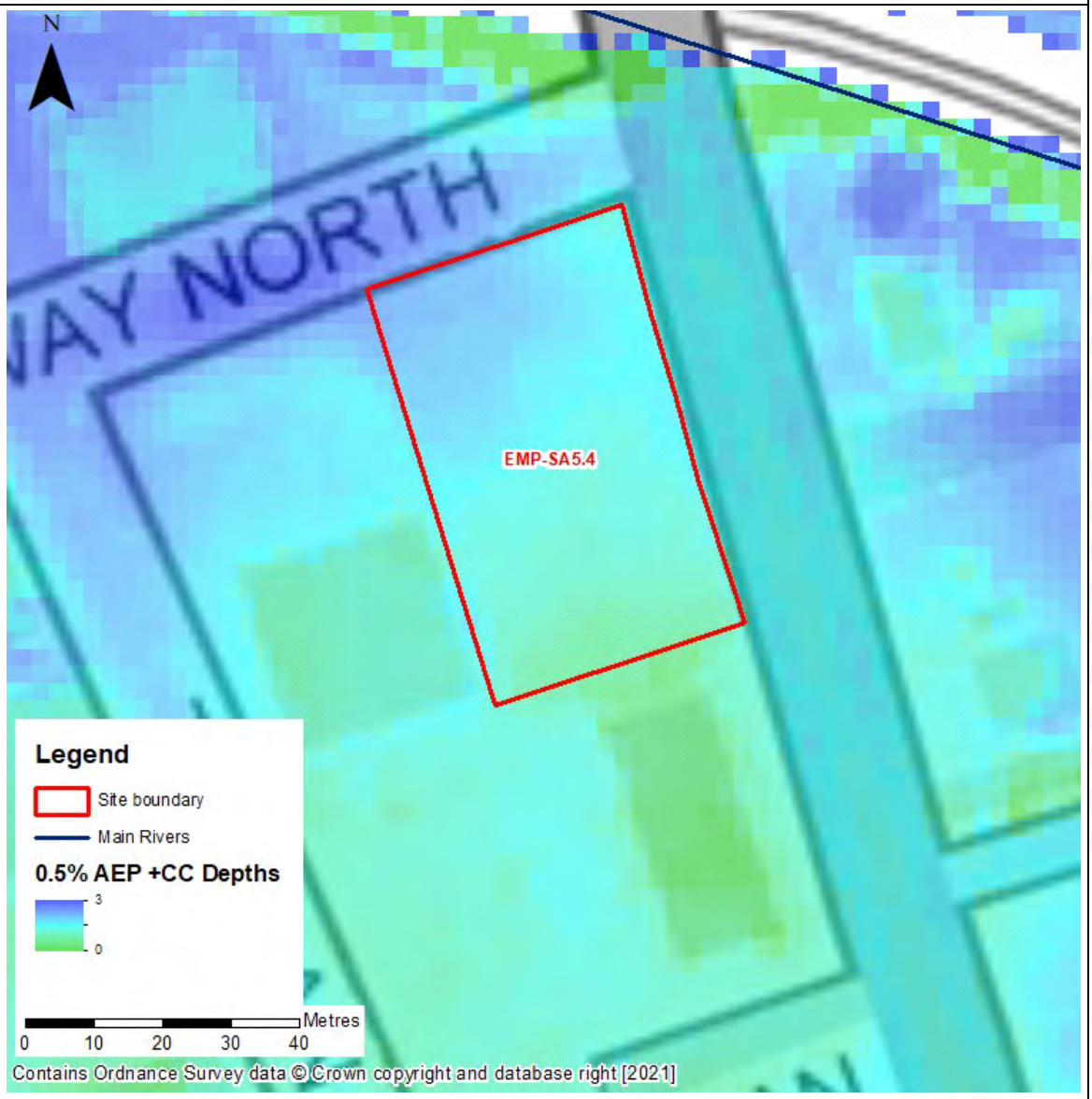


Figure 4: modelled tidal flood depths for present day 0.5% AEP event

Note: depth grid erased from open water channel to provide more accurate representation of flood depths onsite

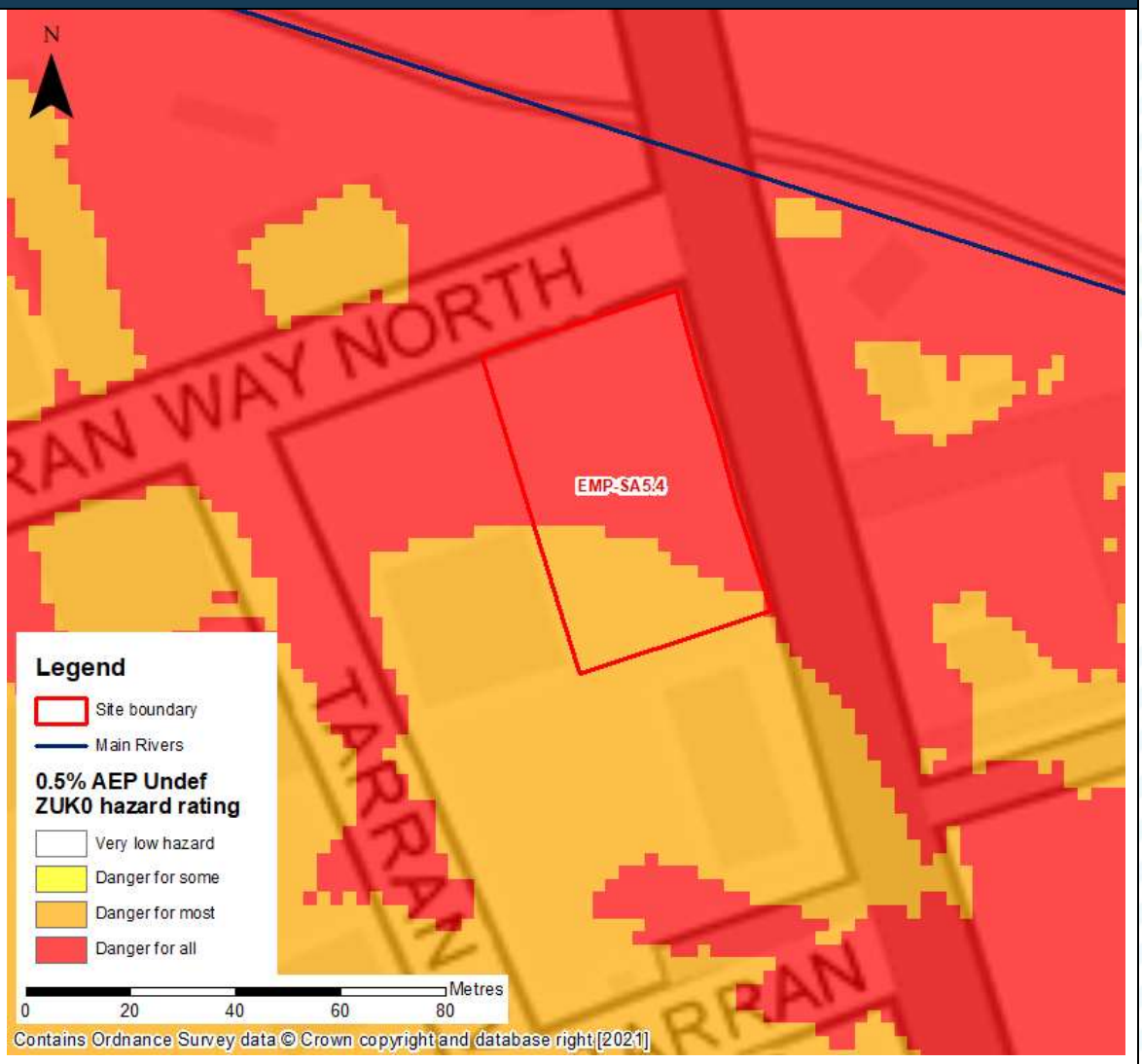
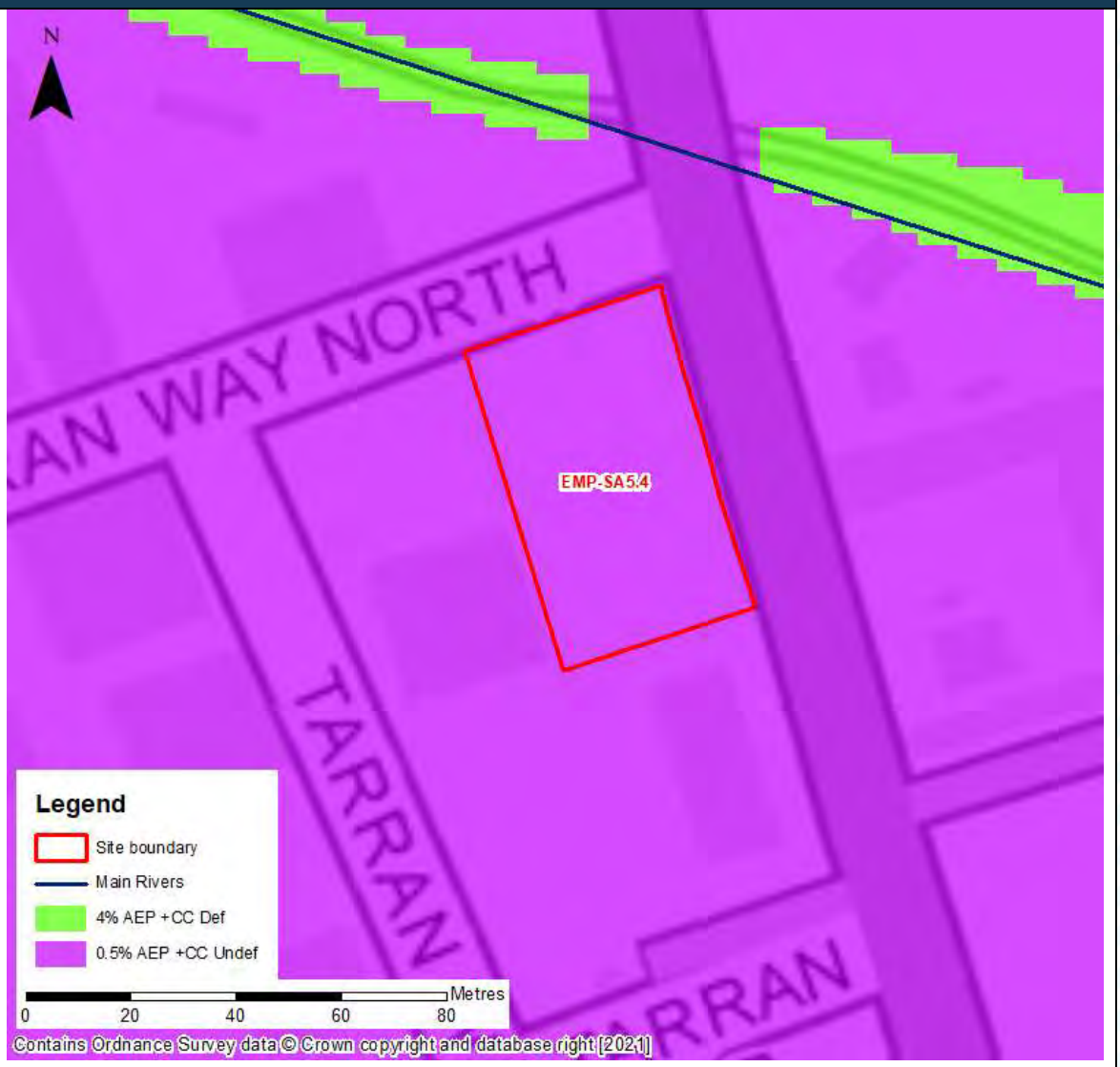
EMP-SA5.4: Land at Tarran Way North, Moreton	
	

Figure 5: modelled tidal flood hazard for present day 0.5% AEP event

EMP-SA5.4: Land at Tarran Way North, Moreton	
	 **Figure 6: modelled tidal flood outlines for the higher central climate change allowance**

EMP-SA5.4: Land at Tarran Way North, Moreton	

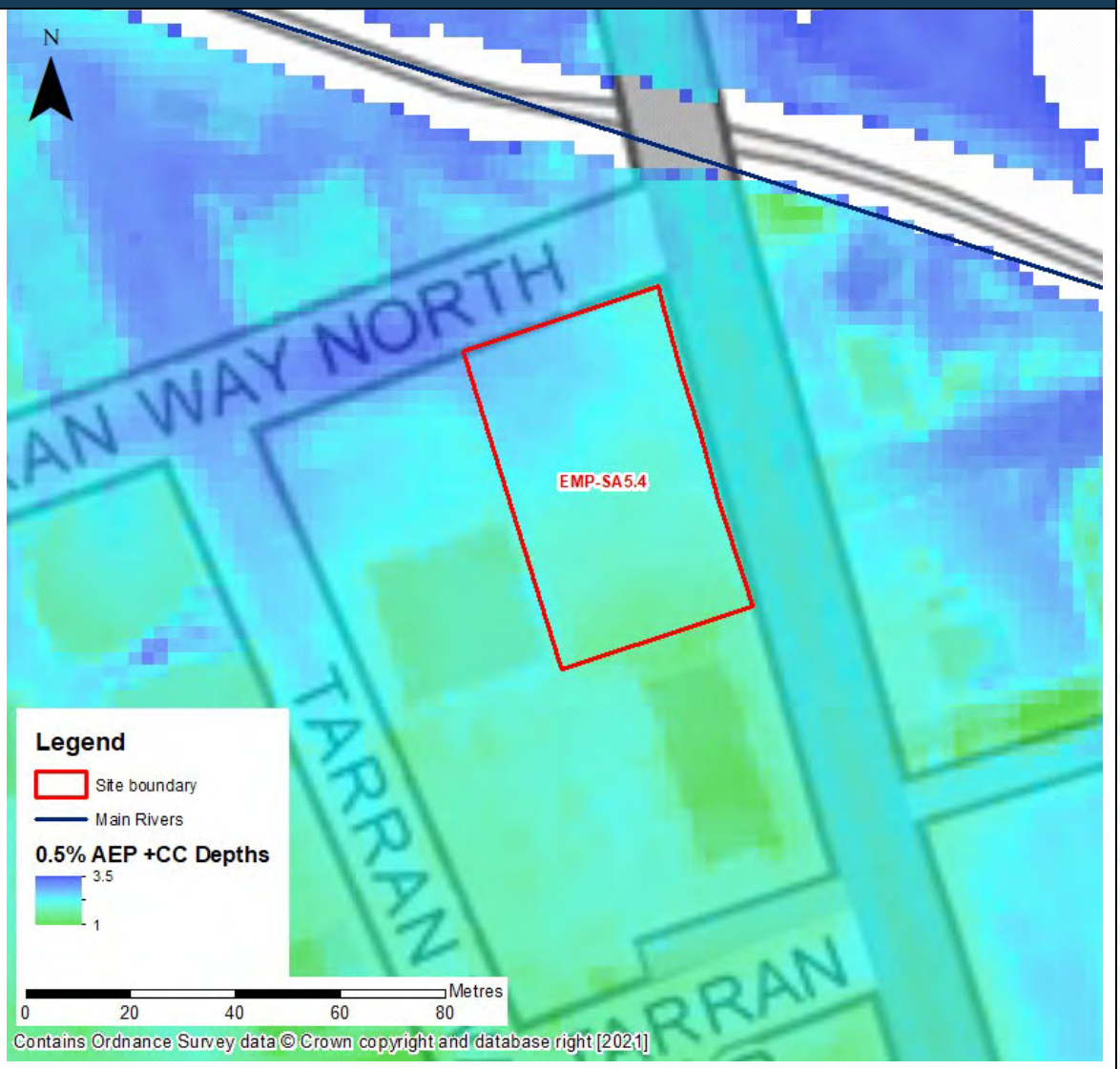
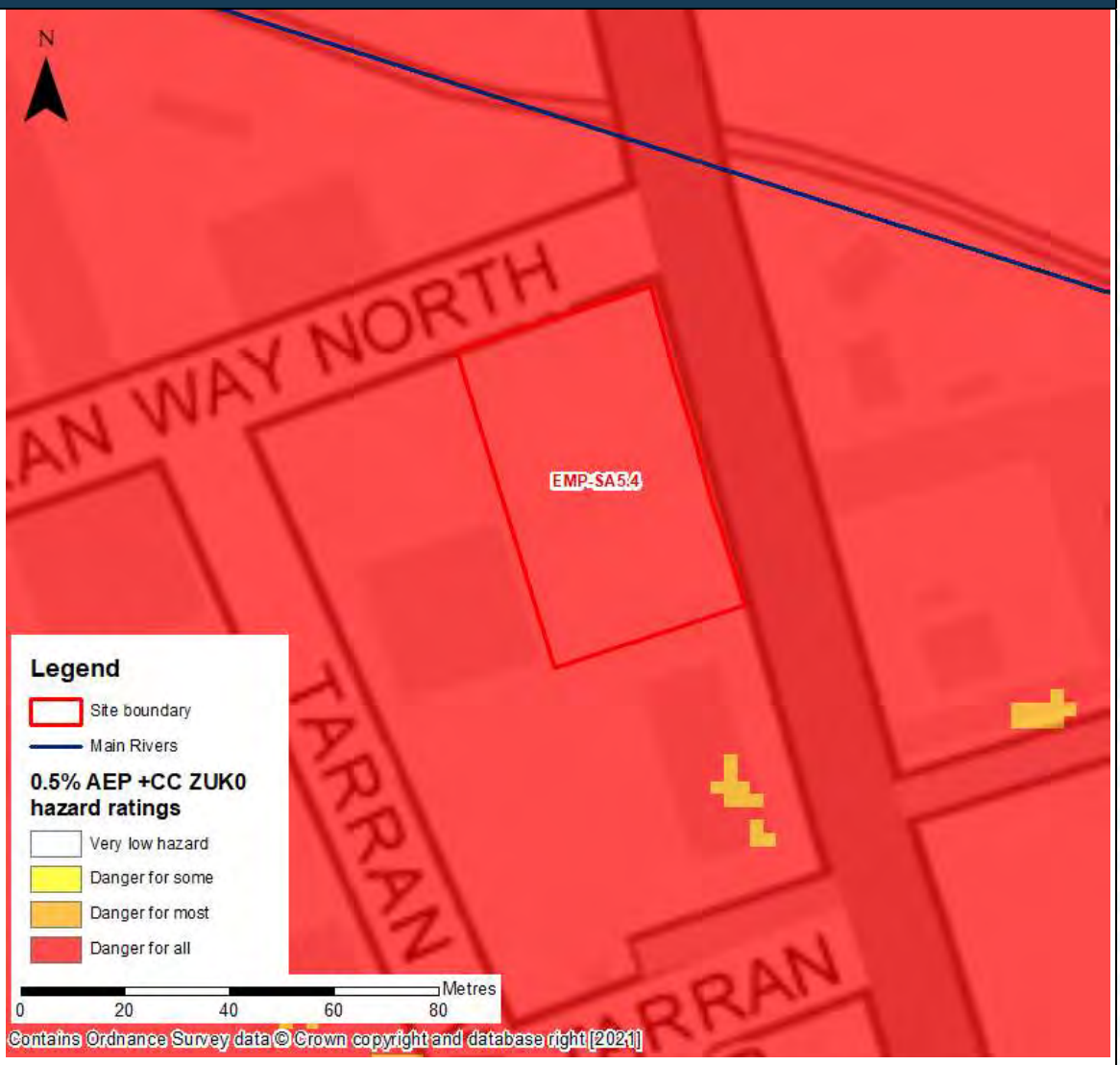


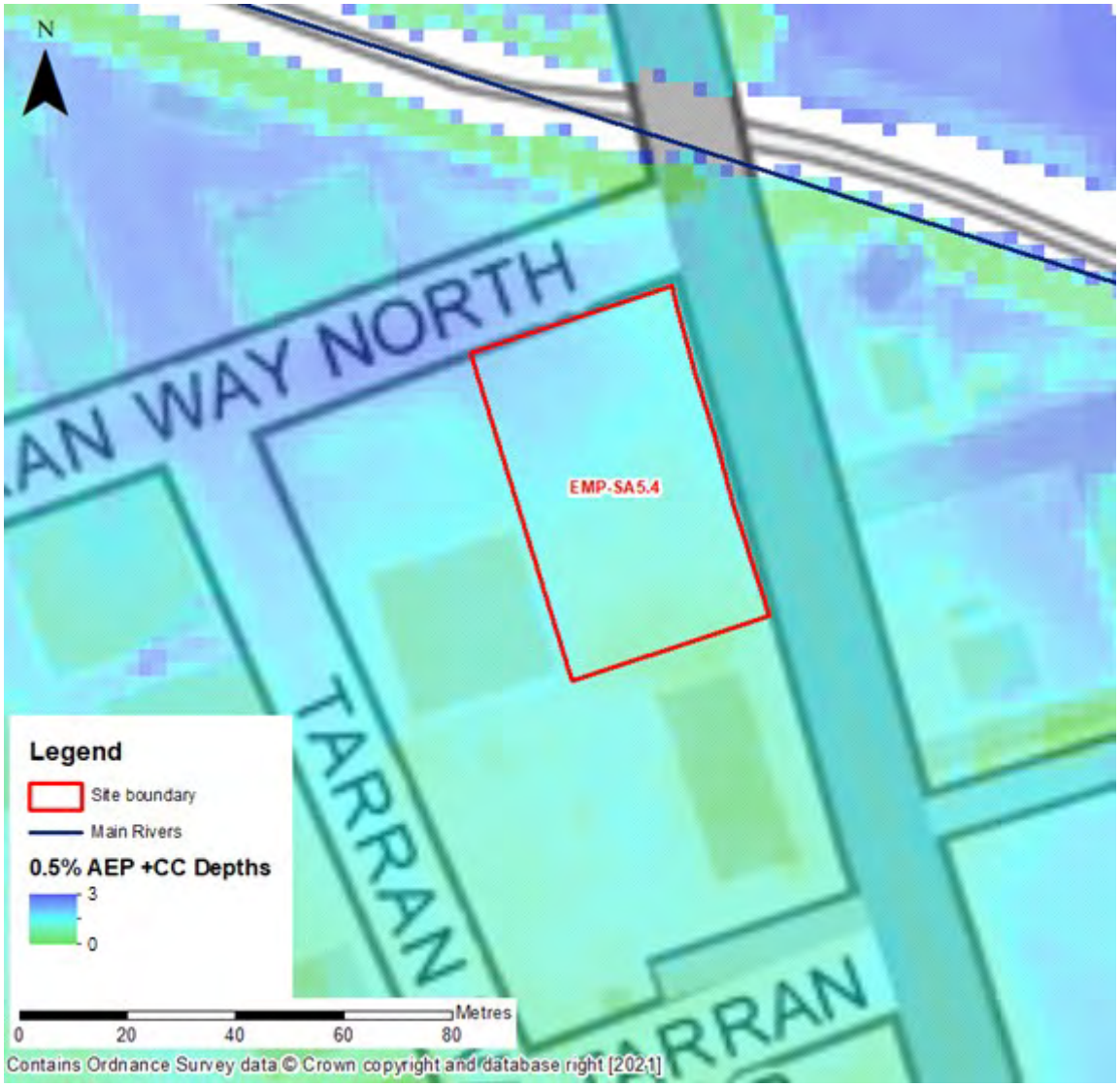
Figure 7: modelled tidal flood depths for 0.5% AEP + climate change event

Note: depth grid erased from open water channel to provide more accurate representation of flood depths onsite

EMP-SA5.4: Land at Tarran Way North, Moreton	
	 **Figure 8: modelled tidal flood hazard for 0.5% AEP +climate change event** **Tidal hazard ratings based on Table 4 of the SUPPLEMENTARY NOTE ON FLOOD HAZARD RATINGS AND THRESHOLDS FOR DEVELOPMENT PLANNING AND CONTROL PURPOSE – Clarification of the Table 13.1 of FD2320/TR2 and Figure 3.2 of FD2321/TR1. May 2008.* The site is at significant existing risk with depths and hazards exacerbated by climate change. For the present day 0.5% AEP event the maximum depth is 1.9 m in the north of the site which increases to approximately 2.9 m in the climate change event. The hazard rating for present day and climate change events is Danger for All.
Historic flooding	There are no areas of historic flooding that affect the site according to the EA's Historic Flood Map (HFM) dataset.

EMP-SA5.4: Land at Tarran Way North, Moreton	
Defences	On the right bank of The Birket, which is closest to the site, there are two embankments which both have design standards of 100 and condition grades of 3 meaning Fair (Table 1.1 Condition Assessment Manual 2012[1]). There are also two flood walls on the right bank of The Birket where it passes under the A551 which have design standards of 100 and condition grades of 3. The whole site lies within the EA's ABD polygon, protected by the Wallasey Embankment along the north coast of the Wirral. The Wallasey embankment is a Council owned defence with a design standard of 200 and a condition grade of 2 meaning Good. The SMP policy is to Hold the Line, therefore the long-term strategy is for the defences to be adequately maintained and upgraded to maintain the status quo. It would be expected therefore that investment in these defences will continue in the long term.
Flood Warning Area	According to the EA's FWA dataset, there are two FWAs in operation that cover the entire site. One for the River Birket at Leasowe with areas at risk including Pasture Lane, Taran Way North, and Ditton Lane with properties at risk off Reed Lane at Reedville Grove, Cornflower Way and Bullrush Drive. The other FWA covers the Irish Sea and Mersey Estuary from the Head of the Wirral to Runcorn affecting areas of Hoylake, Meols, Moreton and Wallasey.
Natural Flood Management / Working with Natural Process	According to the national scale 'potential for WwNP dataset', there is a small section outside the north east corner of the site that may have potential for flood alleviation of slowing the flow through riparian woodland planting. This is also the same for the area surrounding The Birket.

1 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/291126/scho0509bqat-e-e.pdf

EMP-SA5.4: Land at Tarran Way North, Moreton	
Tidal modelling: residual risk	
Breach modelling scenario for the Wallasey embankment	 **Figure 9: modelled tidal depth for the 0.5% AEP plus climate change breach scenario of the Wallasey Embankment**

EMP-SA5.4: Land at Tarran Way North, Moreton

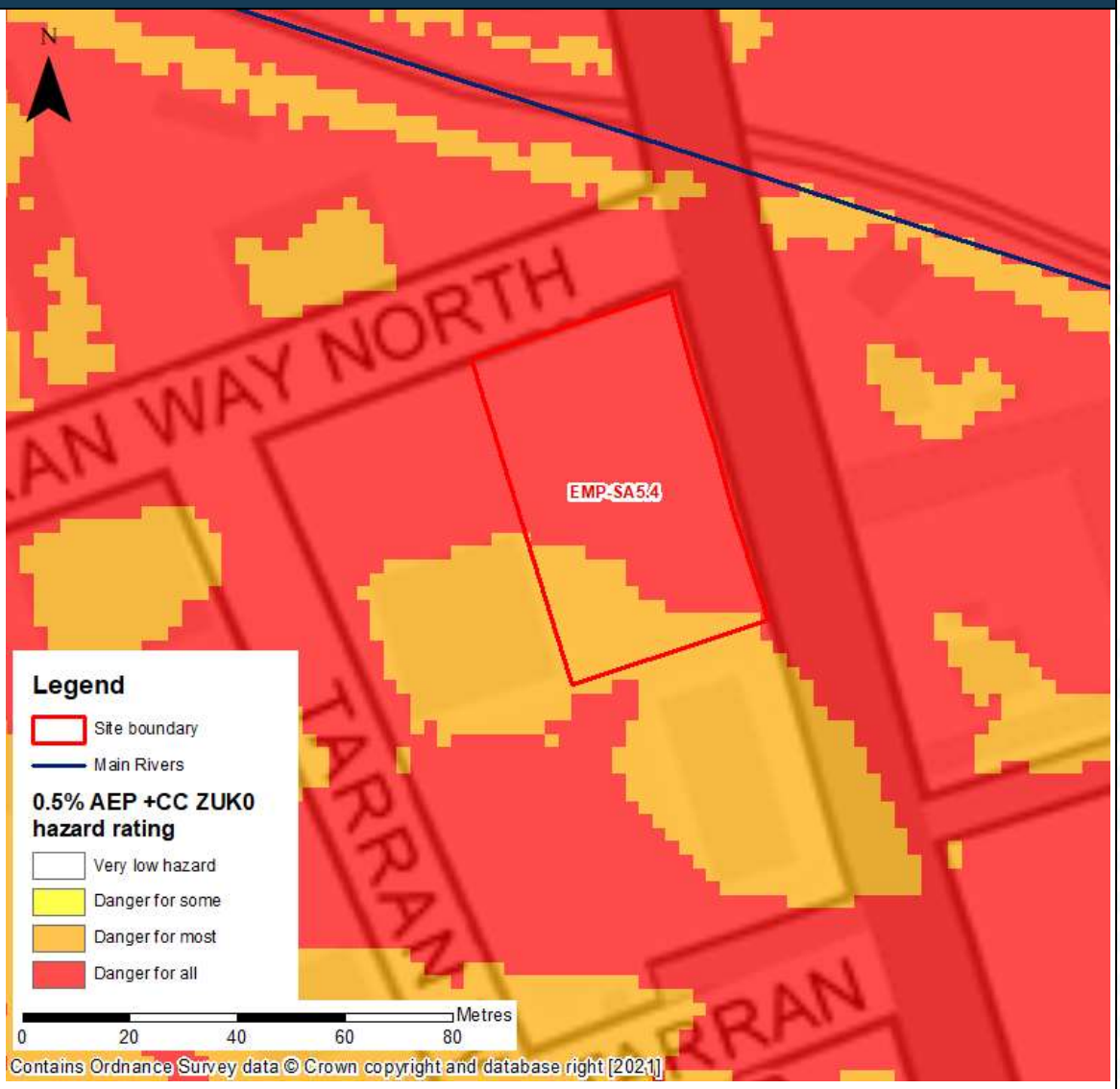


Figure 10: modelled tidal hazard for the 0.5% AEP plus climate change breach scenario of the Wallasey Embankment

The present day 0.5% AEP breach scenario of the Wallasey embankment does not impact the site. However, the site is at significant residual risk in the long term from climate change to a maximum depth of 2 m in the north of the site and a Danger for All hazard rating for the majority of the site.

Although the modelling outputs show significant risk in the long term, the Shoreline Management Plan strategy on this section of coastline is to hold the line. Given the large area of Wirral at risk from such a breach of the Wallasey Embankment, it is unlikely that Wirral Council would cease funding for maintenance and defence improvements into the future.

EMP-SA5.4: Land at Tarran Way North, Moreton	
Observations, mitigation options & site suitability: tidal	- The whole site is at flood risk from Flood Zone 3a. According to the Flood Map for Planning, the risk is tidal but there is also risk to the surrounding area and River Birket which is a combination of fluvial and tidal risk. Less vulnerable uses are appropriate in Flood Zone 3a according to the NPPF, assuming appropriate resilience measures are in place. The site is also within a ABD, protected by the Wallasey Embankment from tidal flooding. - In mapping ABDs, the EA assumes that flood defences and other operating structures act perfectly and give the same level of protection as when the previous assessment of the area was made. Consultation with the LLFA on the condition and maintenance arrangements of the Wallasey Embankment should be carried out however it would be expected, given the SMP policy of 'hold the line' that investment in the defences will continue in the long term. - According to the EA's Spatial Flood Defences dataset, the defences on The Birket are in fair condition and may have defects that could reduce performance of the asset. The EA should be consulted as to the actual condition of these defences and should provide any details on possible refurbishment or replacement. However, at this stage is not known whether these defences provide any protection to the site. - The present day 0.5% AEP breach scenario for the Wallasey embankment does not impact the site. However, the site is at significant residual risk in the long term from climate change to a maximum depth of 2 m in the north of the site and a Danger for All hazard rating for the majority of the site. This breach event highlights the significant risk this site and the north Wirral coastline is at from climate change. - Safe access and egress are not considered to be achievable based on the Wirral Tidal model 0.5% AEP outline due to total inundation of the A551 to the east of the site with depths of approximately 1.5 m and Tarran Way North to the north of the site as the depths are around 2.2 m. However, the site is within a ABD and several flood warnings are in place to warn users of the development of potential flood events occurring. - Land raising may be a viable option to raise ground floors above the 0.5% AEP event +climate change maximum level which is approx. 2.9 m. The EA would also recommend a further 600mm above the design flood level. Given the modelled onsite depths are significant, land raising would likely be a costly solution. - Stilted design may also be an option though is likely to be an expensive design solution with access and egress routes also required to be above the design flood level.
Flood source: infrastructure failure – reservoirs (residual)	
Flood risk: reservoir	There is no risk of flooding to the site as a result of dam failure, according to the EA's online RFM.
Flood source: infrastructure failure – canals (residual)	
Flood risk: canal	There are no canals in the vicinity of this site.

EMP-SA5.4: Land at Tarran Way North, Moreton			
Flood source: surface water			
Surface Water Flood Risk to Proposed Development Site			
Current site: Risk of Flooding from Surface Water map	High Risk (3.3% AEP event)	Medium Risk (1% AEP event)	Low Risk (0.1% AEP event)
	0%	0%	4.3%
Surface water max flood depths	Not applicable	Not applicable	0.15 – 0.3 m

EMP-SA5.4: Land at Tarran Way North, Moreton

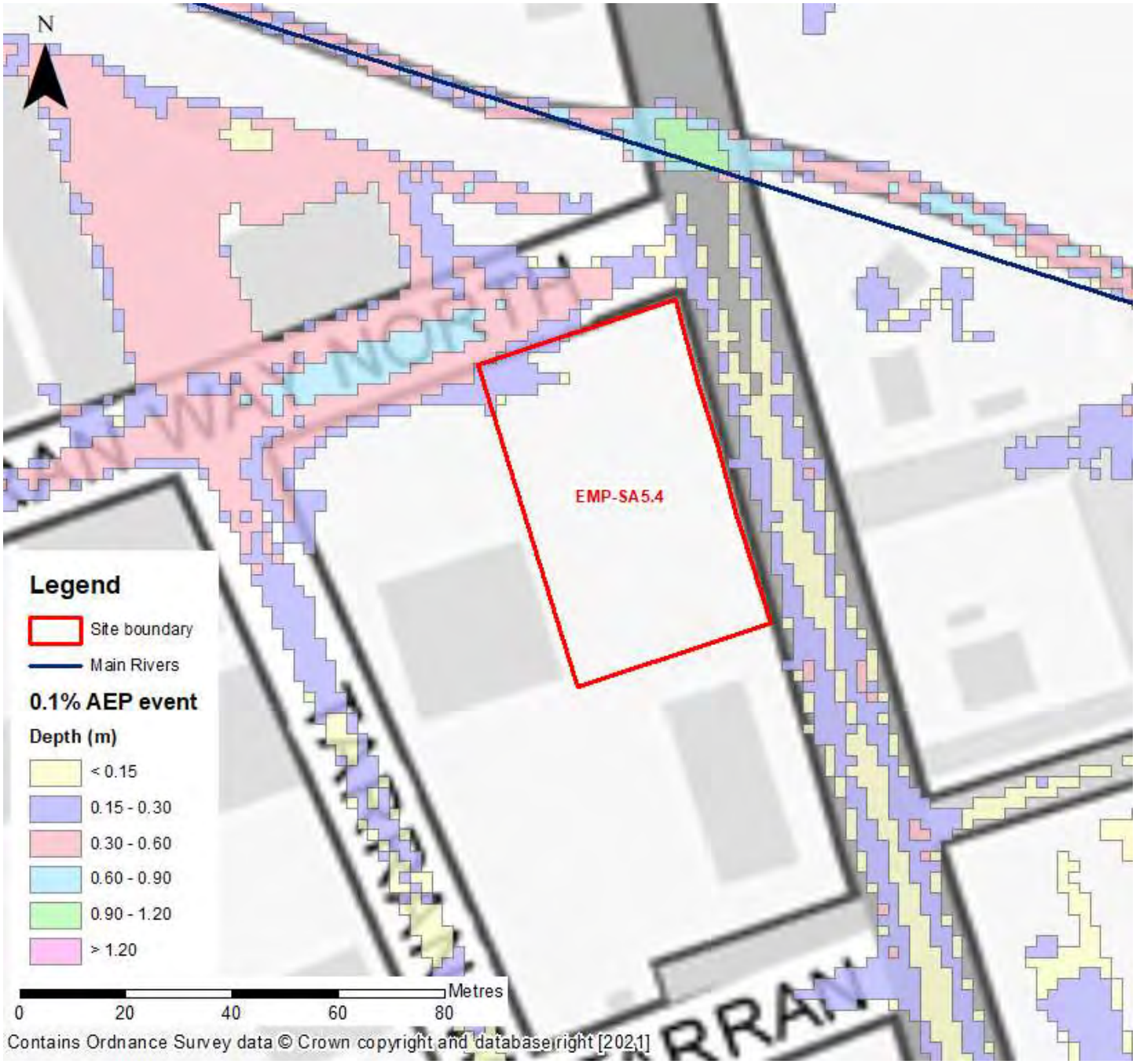


Figure 11: 0.1% AEP event surface water flood depths (Risk of Flooding from Surface Water map)

EMP-SA5.4: Land at Tarran Way North, Moreton

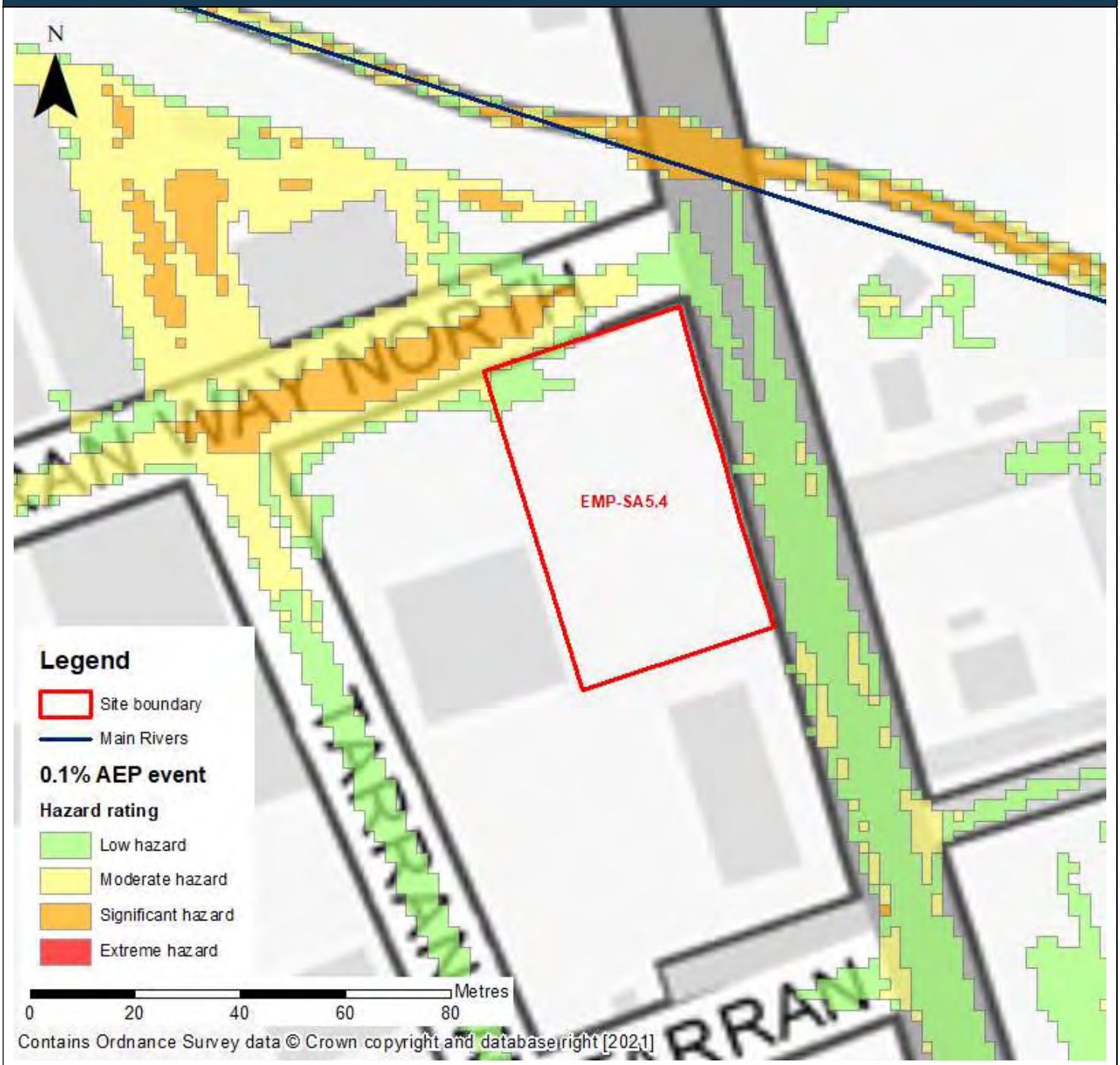
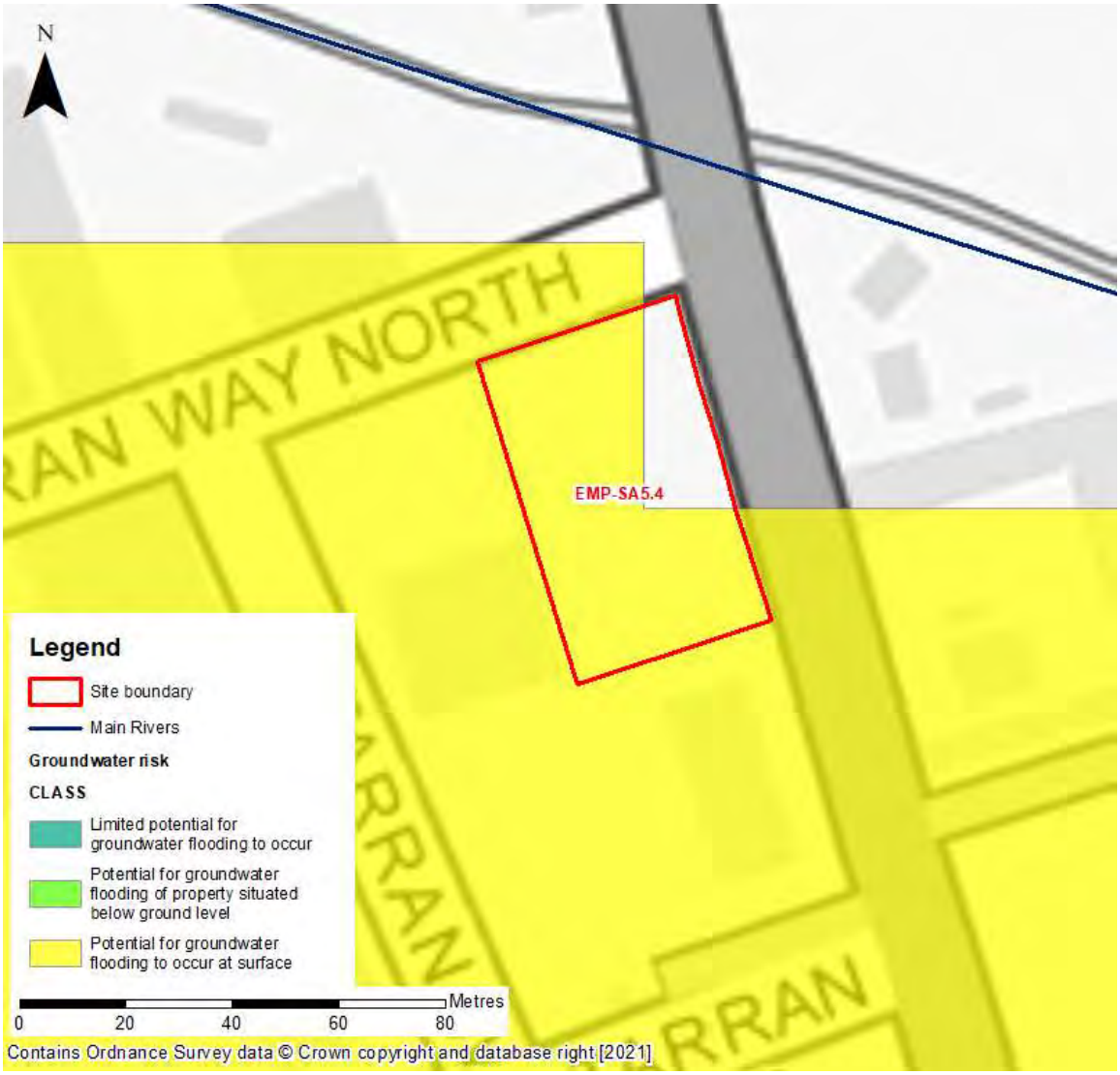


Figure 12: 0.1% AEP event surface water flood hazards (Risk of Flooding from Surface Water map)

**Surface water hazard rating based on Table 4.2 Hazard to People as a Function of Velocity and Depth, R&D OUTPUTS: FLOOD RISKS TO PEOPLE: PHASE 2 FD2321/TR2. Defra. March 2006.*

Surface water flood risk to development site	Present day surface water risk to the site is nominal.
Climate change	The current day 0.1% AEP event outline provides an indication of the likely increase in extent of the more frequent events.

EMP-SA5.4: Land at Tarran Way North, Moreton						
	Long term surface water risk also appears minimal and safe access and egress routes should be available from the A551.					
Observations, mitigation options & site suitability: surface water	- A drainage strategy would be required to ensure there is no increase in surface water flood risk elsewhere as a result of new development. Consultation with the LLFA required.					
Surface Water Flood Risk from Proposed Development						
Runoff rates should not exceed current rates and if possible, betterment of existing rates should be aimed for. For the purposes of this assessment, the required volumes of attenuation have been calculated below based on an assumed 85% impermeable area and limiting greenfield runoff rate of Qbar (l/s).						
Proposed development limiting runoff rate: (l/sec) (FEH Statistical) Qbar: 0.81 l/s (assume 5 l/s minimum discharge) Q30: 1.38 l/s (assume 5 l/s minimum discharge) Q100: 1.69 l/s (assume 5 l/s minimum discharge)						
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
30yr Rainfall+20%	2	93	25	68	5.4	0.005 ha 1.813 %
30yr Rainfall+40%	2.25	112	28	84	6.6	0.006 ha 2.24 %
100yr Rainfall+20%	2.75	139	35	104 (36 exceedance storage)	8.2	0.007 ha 2.773 %
100yr Rainfall+40%	3.25	168	41	127 (43 exceedance storage)	10.1	0.008 ha 3.387 %
Climate change	Application of the central (+20%) and upper end (+40%) allowances for potential change anticipated for the 2080s in the table above shows the estimated attenuation volumes for the 1% AEP and 3.33% AEP rainfall events.					
Surface water: flood risk impacts from development site, mitigation & SuDS	As part of this Level 2 SFRA we have included calculations to provide an estimated land take if a pond with an assumed depth of 1.5m was included as part of the development. Attenuation volumes are presented for the critical storm duration for the 3.33% AEP event with exceedance flows quantified up to the 1% event. To prevent development worsening flood risk elsewhere, surface water runoff must be managed on site.					

EMP-SA5.4: Land at Tarran Way North, Moreton	
Flood Source: Groundwater	
Flood risk: groundwater	 **Figure 13: Susceptibility of groundwater flooding (BGS national dataset)** Based on geological and hydrogeological information, the BGS dataset can be used to identify areas where geological conditions could enable groundwater flooding to occur and where groundwater may come close to the ground surface. The dataset should not be used on its own to make planning decisions at any scale and should not be used to inform planning decisions at the site scale. The susceptibility data cannot be used on its own to indicate risk of groundwater flooding. The dataset shows that there is potential for groundwater flooding to occur at the surface across the majority of the site. Ground investigations should therefore be carried out onsite to confirm groundwater table conditions.
Overall Site Assessment	
Access and egress	Safe access and egress routes are achievable in present day conditions when accounting for defences. The EA's flood warning system that is in place should ensure site users can evacuate the site ahead of any potential flood event. Any FRA for the site must include an Emergency Plan focused on the timely evacuation

EMP-SA5.4: Land at Tarran Way North, Moreton	
	of site users ahead of any flood event occurring. Alternative plans may have to be made in the longer term as a result of climate change.
Recommendation summary	Based on the evidence presented in the Level 1 SFRA and this Level 2 SFRA: - Early discussions should take place with the EA with regards to flood risk issues on this site. The EA offers early engagement through an advisory service via their website (https://www.gov.uk/guidance/developers-get-environmental-advice-on-your-planning-proposals) or by emailing the local office: SPPlanning.RFH@environment-agency.gov.uk. - Given the site is wholly within an ABD protecting the site against tidal risk, the EA and/or LLFA should be consulted specifically for details on the flood defences i.e. condition, maintenance arrangements for the lifetime of the development. - Assess options for land raising to protect against the climate change flood level. - Any consideration for development must fully investigate the options presented in this Level 2 SFRA, including for the provision of safe access and egress routes at all times. - Detailed emergency plans will be required alongside the EA's flood warnings to ensure the safe evacuation of site users in advance of a flood event occurring.
Can the second part of the Exception Test be satisfied?	Site not subject to the Exception Test though development is appropriate according to the NPPF, subject to suitable FRA including for effective mitigation against climate change.
FRA requirements	- Land raising options should be assessed, including raised escape routes. - The FRA should fully assess emergency planning arrangements and should include a full Emergency Plan for the site. - Flood resilience measures should be included in the site design at an early stage of planning - Any FRA should be carried out in line with the NPPF; FRCC-PPG; Local Plan and LLFA policies; and national and local SuDS policy and guidelines. - Throughout the FRA process, consultation should be carried out with the following, where applicable, the LPA; LLFA; emergency planning officers; EA; UU; the highways authorities; and the emergency services.

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Wirral Level 2 Strategic Flood Risk Assessment

Site RES-RA2.1

Final Report

April 2022

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WIRRAL

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Revision History

Revision Ref / Date	Amendments	Issued to
V1.0 Draft September 2021	-	John Entwistle
V2.0 Draft December 2021	Council and EA comments addressed	John Entwistle
V2.0 Final February 2022		John Entwistle
V3.0 Final April 2022	Adjustment to site boundary and area	John Entwistle
V4.0 Final April 2022	Council comments addressed	John Entwistle

Prepared by ..... Hannah Bishop BSc MSc

Assistant Analyst

Reviewed by ..... Mike Williamson BSc MSc CGeog FRGS EADA

Principal Flood Risk Analyst

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NPPF	National Planning Policy Framework
RFM	Reservoir Flood Map
RoFSW	Risk of Flooding from Surface Water
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Drainage Systems
UU	United Utilities
WFD	Water Framework Directive

RES-RA2.1: Land East of Birkenhead Road	
Location	Land East of Birkenhead Road, Seacombe (North)
Site area (ha)	1.91
Watercourse	The Birket/East Float
EA Model used	Mersey Estuary 2018 (includes tidal Birket)
Existing use	Industrial and brownfield
Existing site flood risk vulnerability classification (NPPF)	Less vulnerable
Proposed use	Residential
Proposed development flood risk vulnerability classification (NPPF)	More vulnerable
Proposed development impermeable area (ha)	1.62

RES-RA2.1: Land East of Birkenhead Road

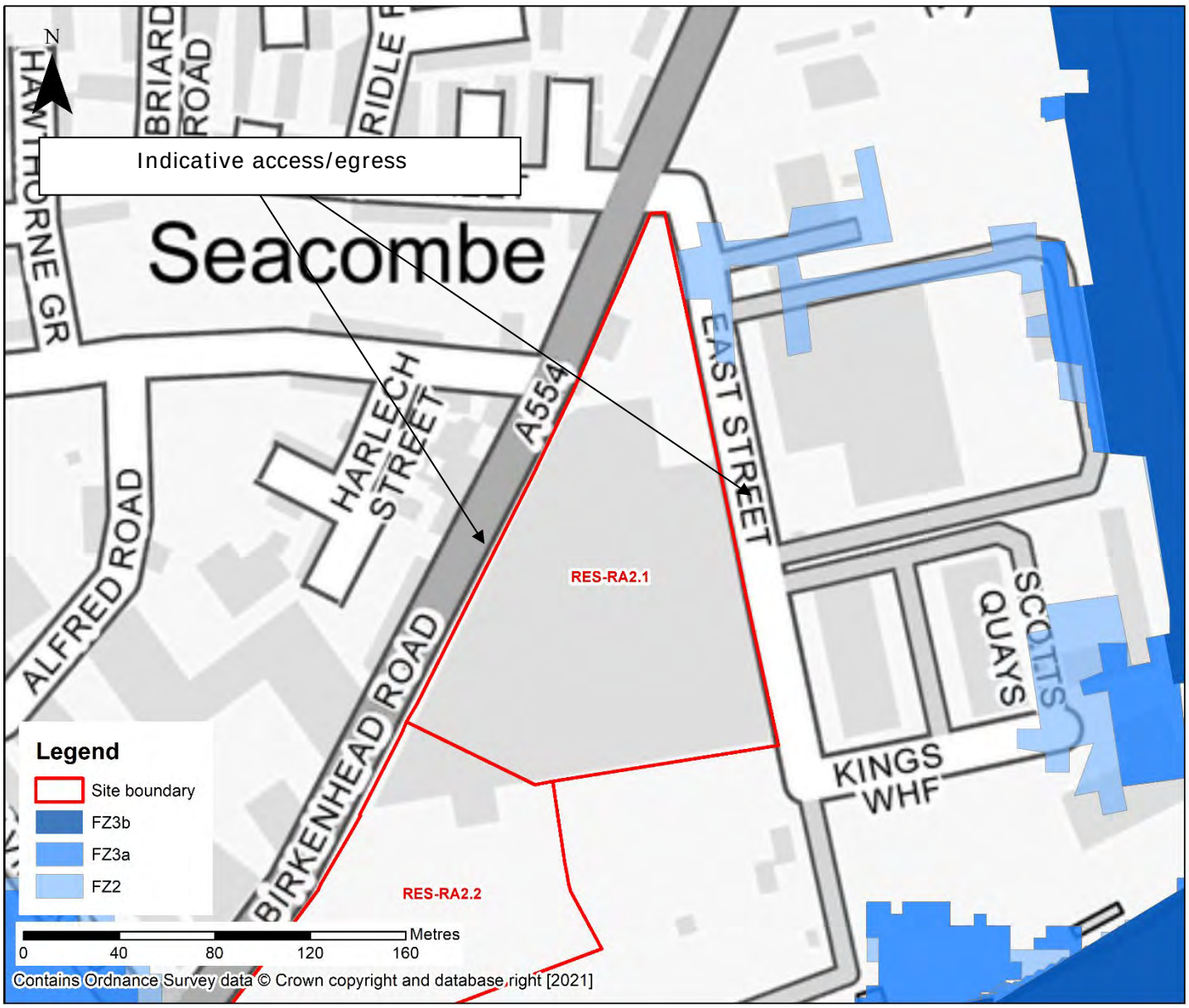


Figure 1: Existing tidal and fluvial flood zones, and flood risk data

The site is wholly within Flood Zone 1. The Shoreline Management Plan policy in place for this stretch of coastline is 'hold the line'.

RES-RA2.1: Land East of Birkenhead Road

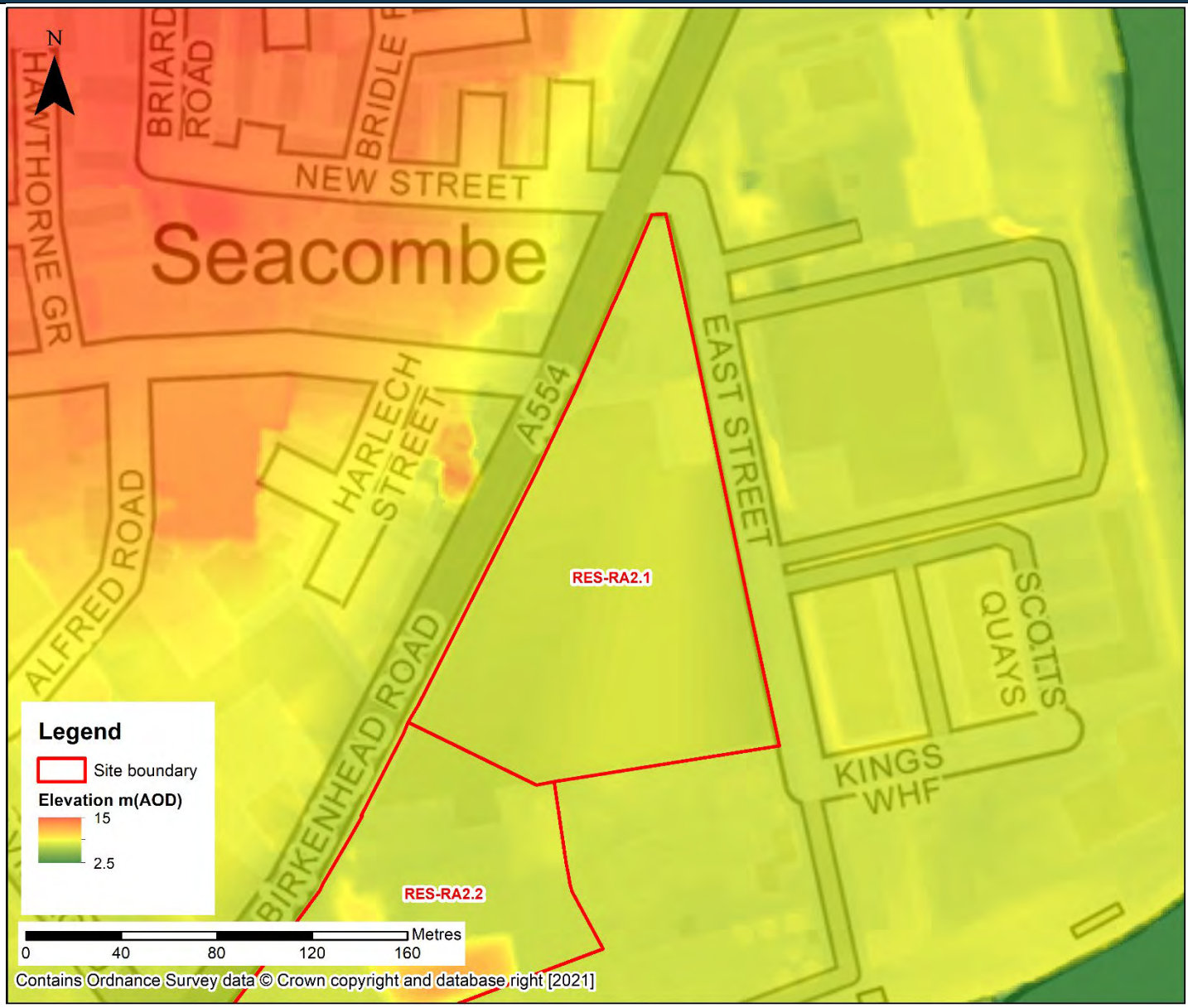


Figure 2: Topography

The elevation across the site predominantly remains the same at around 7 mAOD. To the north west of the site there is an area of higher elevation of approximately 13 mAOD on average.

Flood Source: Tidal

Flood Zones	Flood Zone 3b	Flood Zone 3b +climate change*	Flood Zone 3a	Flood Zone 3a +climate change*	Flood Zone 2
	0%	+30.1%	0%	+100%	0%
Tidal: maximum depth	Not available	0.2 m	N/A	0.72 m	Not available

Flood Zone 3b figures stated based on defended model; Flood Zone 3a and 2 figures stated based on undefended model

*Climate change figures based on 70th percentile (higher central allowance)

RES-RA2.1: Land East of Birkenhead Road

Modelled tidal risk including climate change (Mersey Estuary 2018 model)

NOTE: modelled outputs for this SFRA are subtly different to original 2018 modelled outputs due to upgraded modelling and GIS software

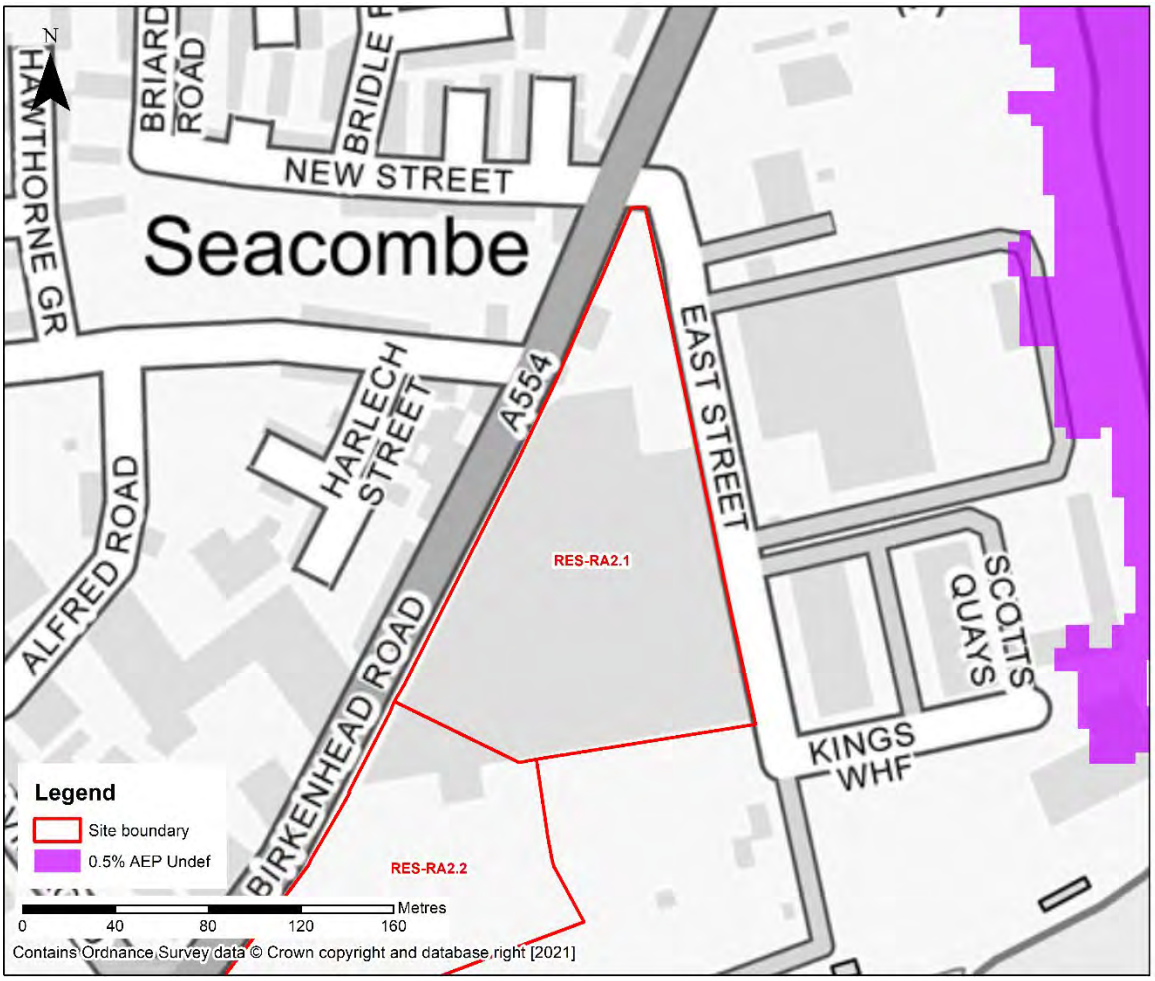


Figure 3: modelled tidal flood outline for present day 0.5% AEP event

NOTE: the modelling outputs presented at this site are from the Mersey Estuary 2018 coastal model only. Although Flood Zone 3 (Figure 1) on the site is stated as fluvial, the modelled outputs are tidal only, hence the difference in Flood Zone 3a in Figure 1 and the modelled tidal 0.5% AEP event outline shown above in Figure 3. However, the risk to the site in the long term is dominated by tidal flooding, as shown in Figure 4 below. The EA has also confirmed that fluvial risk in this area is very low.

RES-RA2.1: Land East of Birkenhead Road

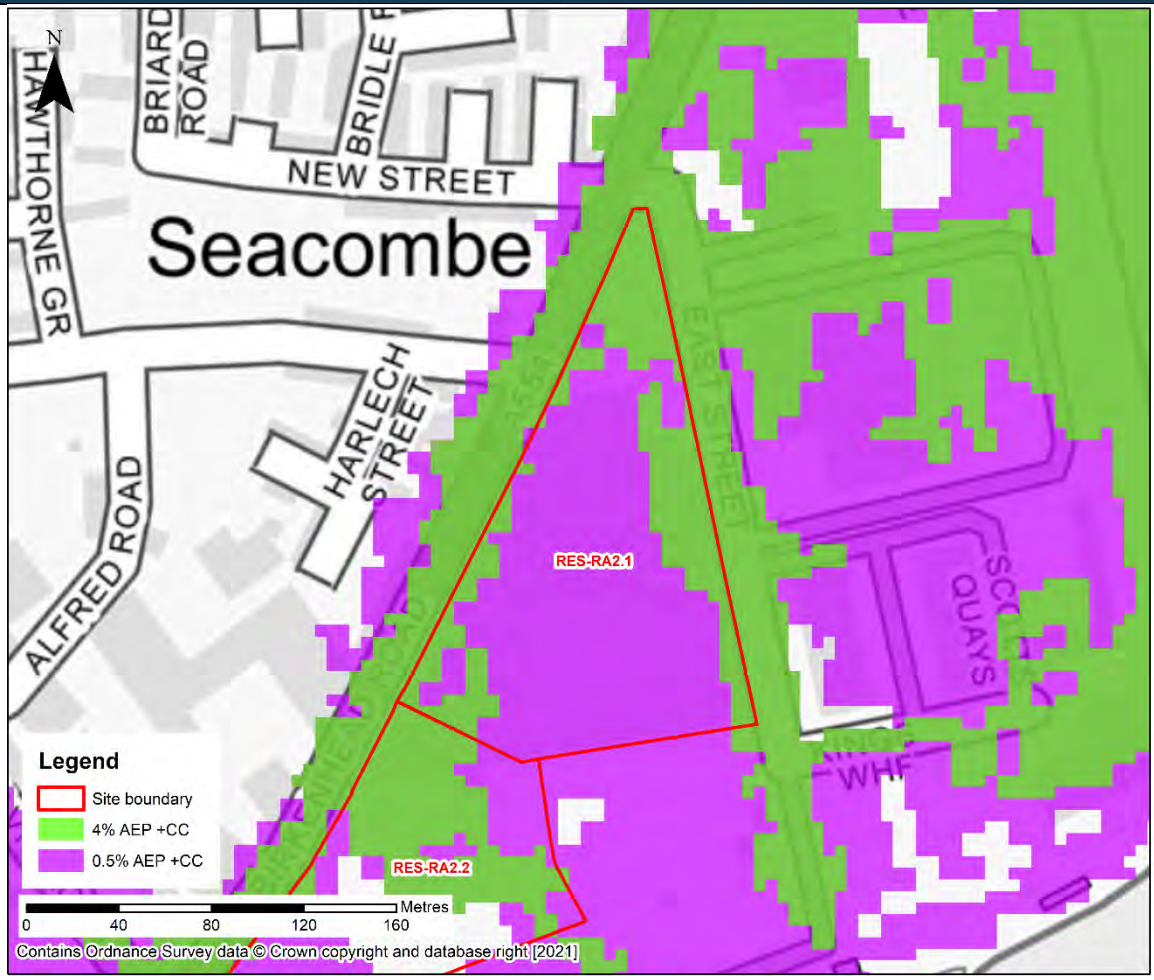
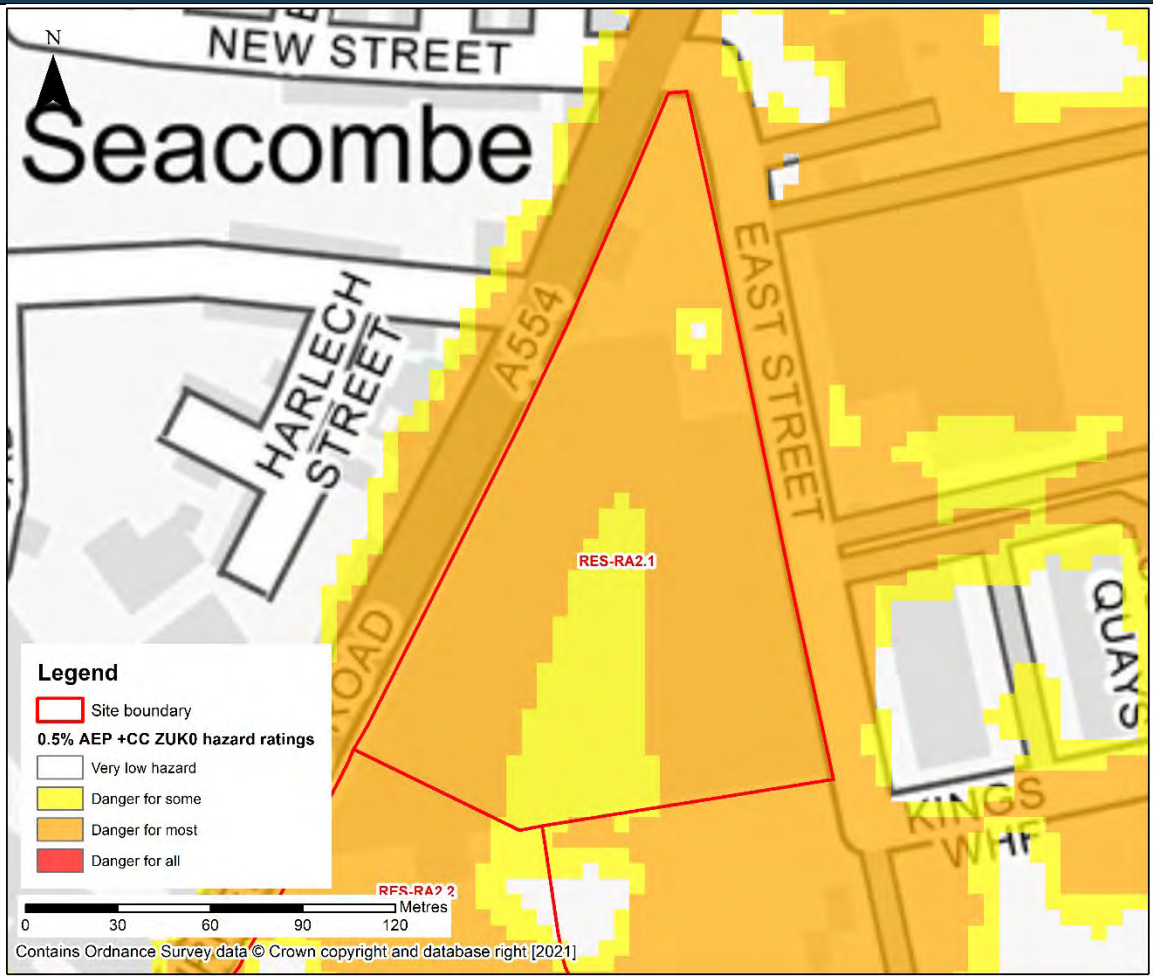


Figure 4: modelled tidal flood outlines for higher central climate change allowance

RES-RA2.1: Land East of Birkenhead Road

Figure 5: modelled tidal flood depths for 0.5% AEP + climate change event

RES-RA2.1: Land East of Birkenhead Road	
	 **Figure 6: modelled tidal flood hazard for 0.5% AEP +climate change event** **Tidal hazard ratings based on Table 4 of the SUPPLEMENTARY NOTE ON FLOOD HAZARD RATINGS AND THRESHOLDS FOR DEVELOPMENT PLANNING AND CONTROL PURPOSE – Clarification of the Table 13.1 of FD2320/TR2 and Figure 3.2 of FD2321/TR1. May 2008.* It is clear from the above figures that climate change will significantly impact the site in the long term.
Tidal modelling: modelled land raising	
Modelled tidal risk including climate change on the coast with modelled land raising (Mersey Estuary 2018 model)	Given the significant risk exhibited at this site when accounting for climate change, it was considered necessary to model land raising of the site as a potential mitigation technique to gauge the offsite effects of this. A simple approach was applied whereby the whole site was uplifted to a set value to ensure the whole site was raised out of the flood zone. In reality, the terrain would be gently regraded and reformed to direct displaced water to, most likely, the adjacent Mersey Estuary. Any FRA for the site should assess this further once site layout options are established. It should be noted that modelled outputs represent land raising at both this site

and sites RES-RA2.2 and RES-RA6.5. Therefore, any decisions made to raise the land at this site should be considered with land raising at the adjacent sites RES-RA2.2 and RES-RA6.5.

The elevation of the site was uplifted by 1.45 m to reflect the maximum levels for the 0.5% + CC (higher central) event +600 mm freeboard, as recommended by the EA. The updated maximum elevation within the site boundary therefore increased to 13.59 mAOD. Figure 8 shows the entire site to be flood free when compared to the baseline 0.5% AEP +CC extent in Figure 4.

As a result of land raising, modelled depths around the majority of the site have decreased compared to the baseline climate change event. This is beneficial to the residential development located around Harlech Street, where depths are around 20mm lower. Depths to the north and east of the site are modelled to increase by around 20mm compared to the baseline event.

The observed decrease in depths to the west are likely to have occurred as a result of floodwaters inundating the north and east of the site first from the estuary and forcing displaced floodwater to be constrained in the area east of the site.

Hazard ratings in the area surrounding the site remain largely similar, with some areas having a reduced hazard rating.

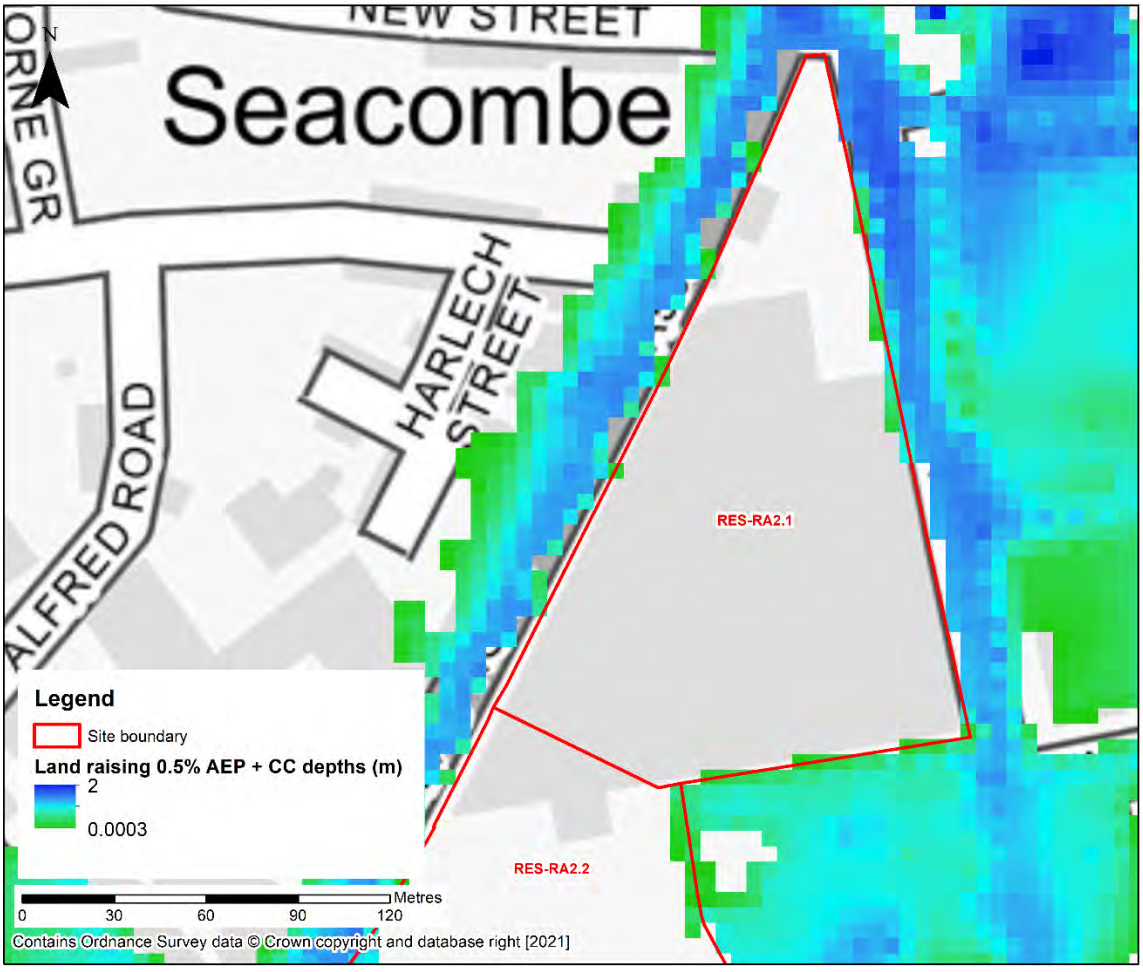
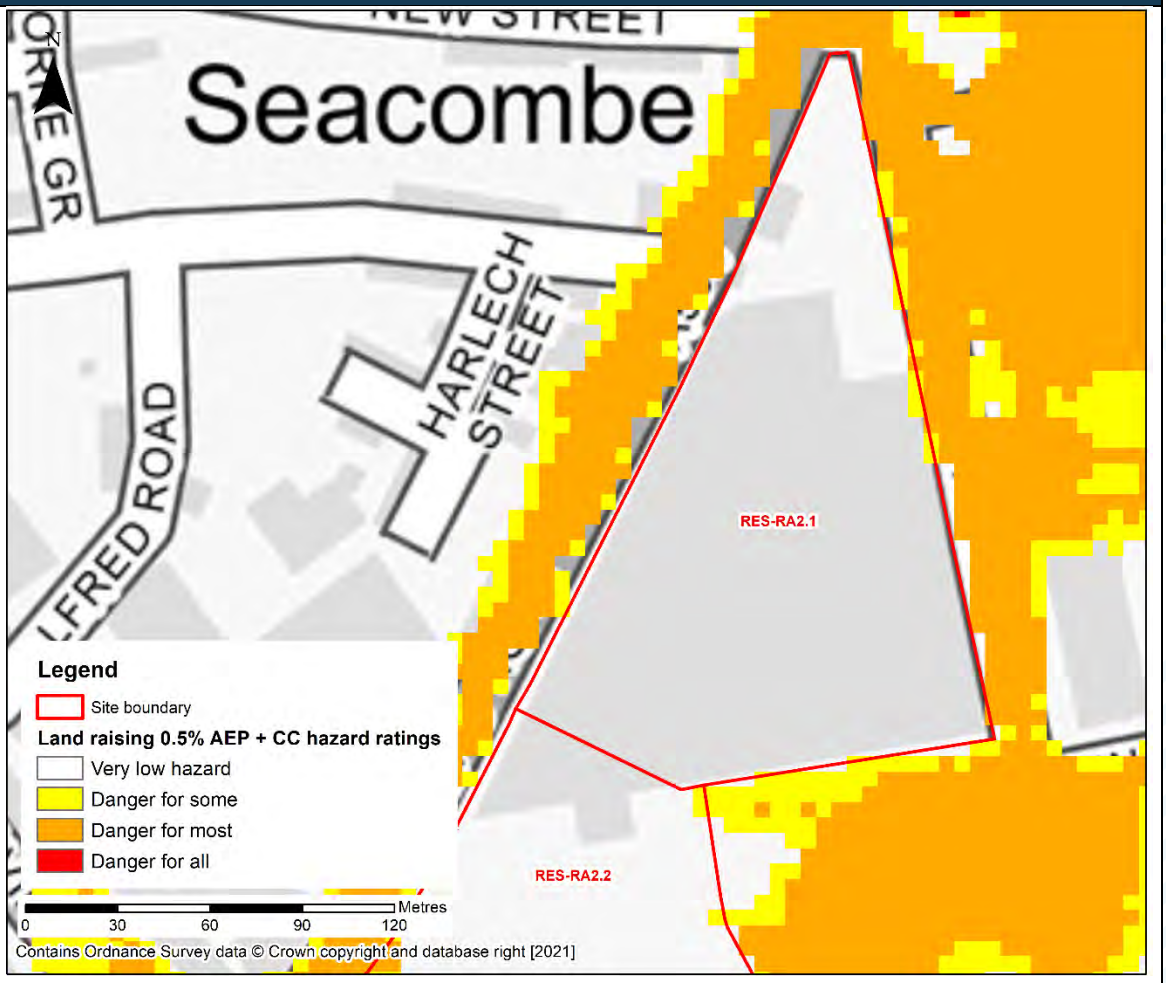


Figure 7: modelled tidal depths for the 0.5% AEP plus climate change land raising scenario

RES-RA2.1: Land East of Birkenhead Road	
	 **Figure 8: modelled tidal hazards for the 0.5% AEP plus climate change land raising scenario**
Historic flooding	There are no areas of historic flooding that affect the site according to the EA's Historic Flood Map (HFM) dataset.
Defences	There is no known flood defence infrastructure in the vicinity of the site.
Flood Warning Area	There are no EA Flood Warning Areas or Flood Alert Areas within the site boundary.
Natural Flood Management / Working with Natural Process	The site lies outside the national scale 'potential for WwNP dataset'.
Observations, mitigation options & site suitability: tidal	- The proposed use of development would see a change in risk classification from less vulnerable to more vulnerable according to the NPPF. - Given the change in use and therefore vulnerability of the site, 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 change of use meets the objectives of the Framework'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).

RES-RA2.1: Land East of Birkenhead Road	
	- The site is at significant long term tidal risk from climate change. The whole site is at risk from the 0.5% AEP event plus climate change to a maximum depth of 0.72 m with a Danger for Most hazard rating. - Given the modelled risk from climate change and the difficulties with access and egress routes, it is recommended this site should not be developed for residential use. Ideally, this site would remain for less vulnerable uses with appropriate resilience measures put in place or be used as a multifunctional greenspace for flood storage, amenity use and to provide environmental/ecological benefits - Safe access and egress routes must be available at all times of flooding. All surrounding access routes are classified as 'danger for most' in the long terms making the provision for escape routes challenging. Any access routes would have to be raised above the 0.5% AEP event +climate change maximum level. - The modelled land raising scenario indicates raising the levels of the site to the 0.5% AEP +CC maximum level, plus 600mm freeboard, would protect the site from tidal flooding in the long term. The modelled depths to the north of the site have increased by around 20mm. Depths to the rest of the area surrounding the site have decreased. - Increased depths to the north of the site may negatively impact existing residential development. Flood defence measures such as raised bunds should be investigated to the north of the site to mitigate any adverse impacts as a result of land raising within the site boundary. The FRA would be required to confirm the feasibility of this. - Although land raising would be a viable option in protecting the site from tidal flooding, access and egress routes would still need to be available during times of flood, therefore raised escape route options should be investigated. - Stilted development may be an option though is likely to be an expensive design solution with access and egress routes also required to be above the design flood level. - A further option may be for ground floor parking or other less vulnerable uses (i.e. non-residential such as shops, restaurants, offices) and for habitable dwellings to be situated on first floor and upwards. However, safe access and egress routes must be available at times of flood, even for above ground floor accommodation. - The SMP policy along the stretch of coast affecting the site is to Hold the Line, therefore the long-term strategy is for the current modelled flood risk to remain and not be exacerbated. - A flood risk activity permit may be required if the development of the site is within 16 metres of the tidally influenced Birket Main River. Details on obtaining a Flood Risk Activity Permit are available from the EA. Also, the EA advises against development within 8m of any watercourse to enable access for maintenance works. - Were development of this site to proceed, given the proximity of this site to the neighbouring RES-RA2.2 and RES-RA6.5, it would be prudent to formulate a strategy to develop these sites in tandem and for consultation between each developer to take place to ensure a joined-up approach for sustainable development is in place, with consideration to the strategic solutions outlined in the Level 2 SFRA Summary Report.

RES-RA2.1: Land East of Birkenhead Road			
Flood source: infrastructure failure – reservoirs (residual)			
Flood risk: reservoir	There is no risk of flooding to the site as a result of dam failure, according to the EA's online RFM.		
Flood source: infrastructure failure – canals (residual)			
Flood risk: canal	There are no canals in the vicinity of the site.		
Flood source: surface water			
Surface Water Flood Risk to Proposed Development Site			
Current site: Risk of Flooding from Surface Water map	High Risk (3.3% AEP event)	Medium Risk (1% AEP event)	Low Risk (0.1% AEP event)
	0.6%	0.9%	3.4%
Surface water max flood depths	0.15 – 0.3 m	0.3 – 0.6 m	0.3 – 0.6 m

RES-RA2.1: Land East of Birkenhead Road

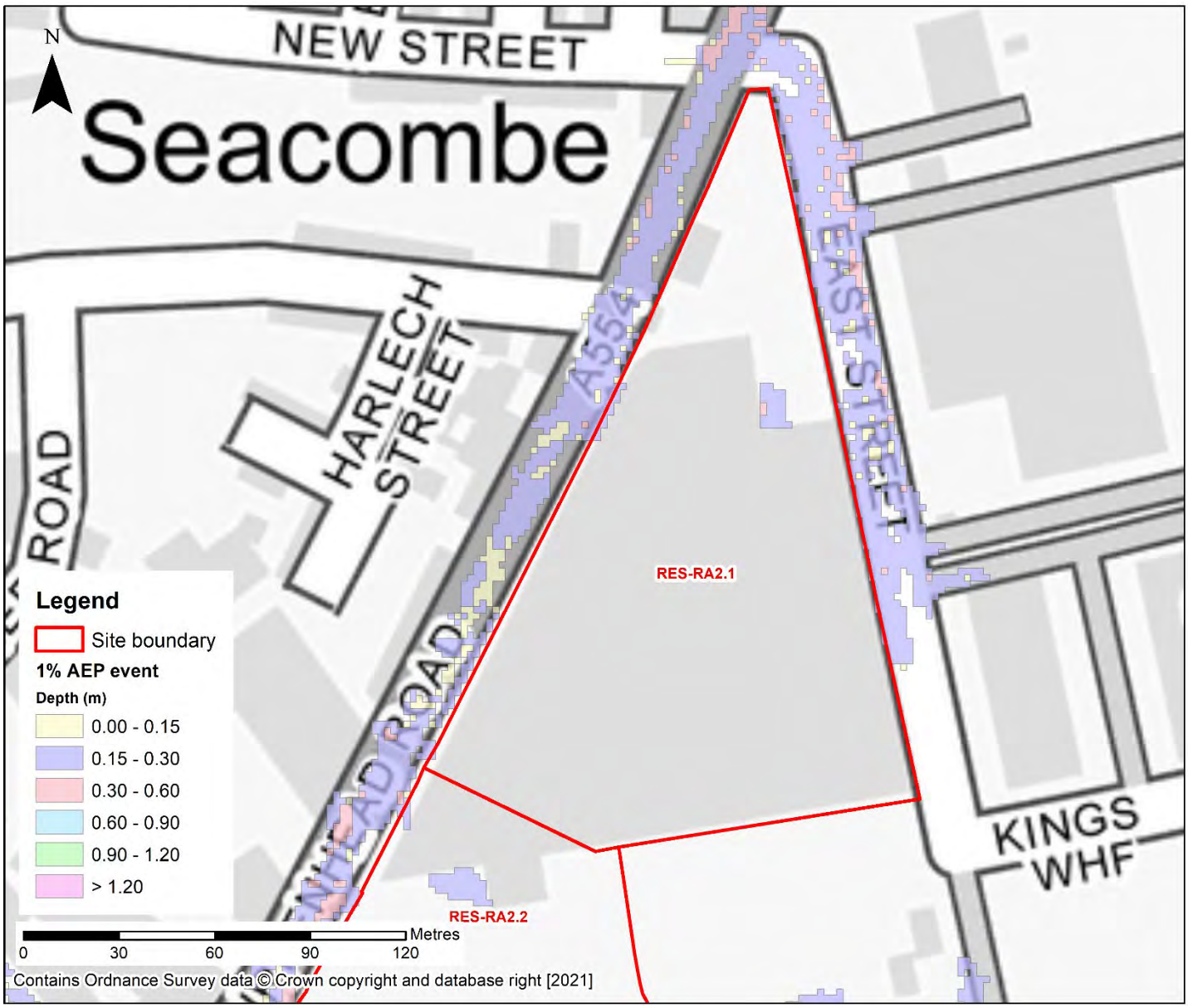


Figure 9: 1% AEP event surface water flood depths (Risk of Flooding from Surface Water map)

RES-RA2.1: Land East of Birkenhead Road

Figure 10: 1% AEP event surface water flood hazards (Risk of Flooding from Surface Water map)

**Surface water hazard rating based on Table 4.2 Hazard to People as a Function of Velocity and Depth, R&D OUTPUTS: FLOOD RISKS TO PEOPLE: PHASE 2 FD2321/TR2. Defra. March 2006.*

Surface water flood risk to development site	There is nominal risk to the site from surface water. Safe access and egress would be achievable via the south east of the site
Climate change	The current day 0.1% AEP event outline provides an indication of the likely increase in extent of the more frequent events. The 0.1% AEP event outline covers approximately 3% of the total site area and the extent is constrained by the existing building within the site boundary and along the roads bounding the site in the north.

RES-RA2.1: Land East of Birkenhead Road	
Observations, mitigation options & site suitability: surface water	- Surface water flow modelling of the site should be carried out to ascertain natural flow paths without the current buildings in place. Flow paths and storage areas could then be built into the design of the site at an early stage. - Assessment of the current drainage system in place should be carried out to ascertain any current capacity issues and whether the current system could accommodate the planned residential development or whether further capacity will be required. - A full drainage strategy would be required to ensure there is no increase in surface water flood risk elsewhere as a result of new development. This will require surface water modelling based on proposed layout plans. Consultation with the LLFA should be carried out on surface water drainage arrangements.

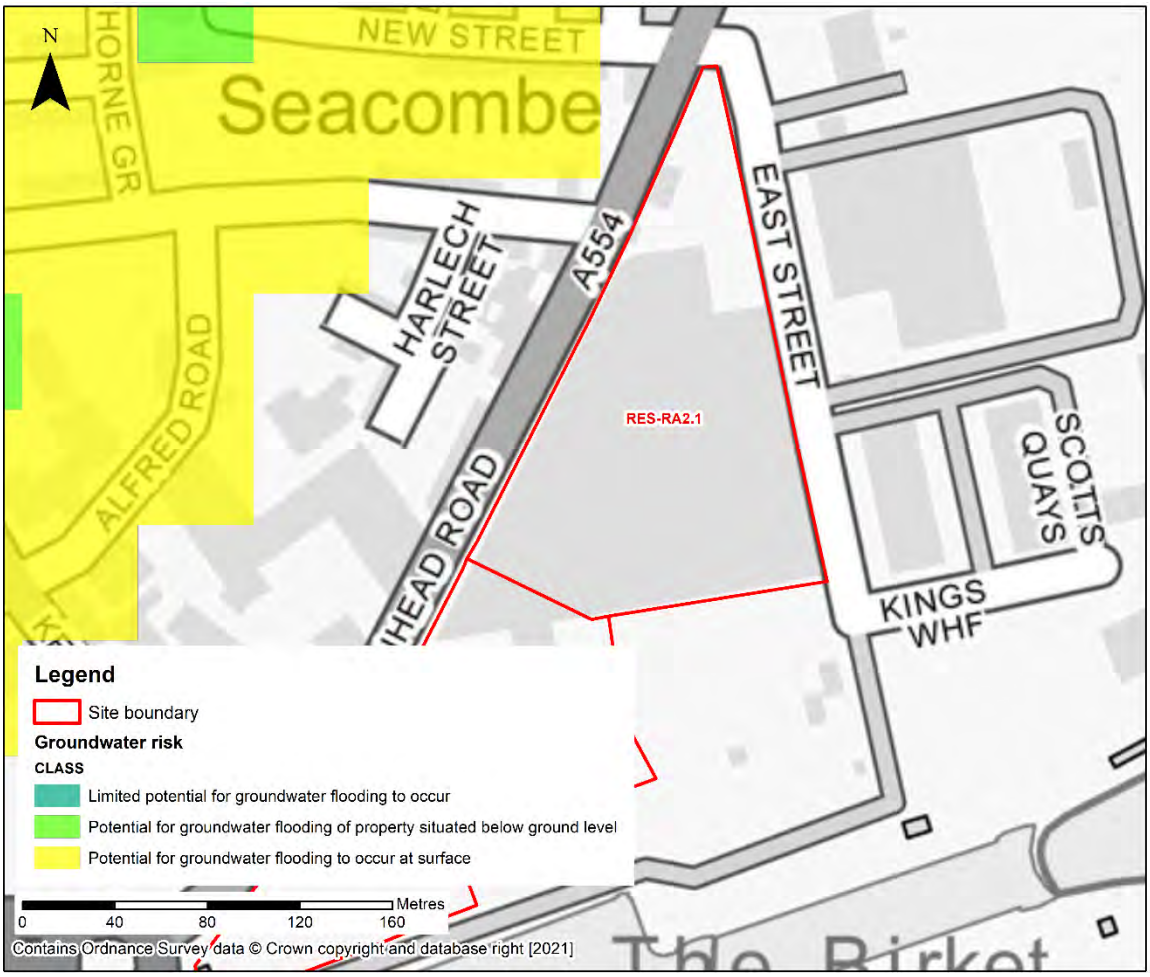
Surface Water Flood Risk from Proposed Development

Runoff rates should not exceed current rates and if possible, betterment of existing rates should be aimed for. For the purposes of this assessment, the required volumes of attenuation have been calculated below based on an assumed 85% impermeable area and limiting greenfield runoff rate of Qbar (l/s).

Proposed development limiting runoff rate: (l/sec)
Qbar: 21.49 l/s (FEH Statistical)
Q30: 36.54 l/s
Q100: 44.70 l/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
30yr Rainfall+20%	7	1785	379	1406	25.9	0.094 ha 2.618 %
30yr Rainfall+40%	8.5	2171	460	1710	31.5	0.114 ha 3.184 %
100yr Rainfall+20%	8.25	2487	447	2040 (634 exceedance storage)	37.6	0.136 ha 3.799 %
100yr Rainfall+40%	9.5	2976	514	2462 (752 exceedance storage)	45.3	0.164 ha 4.585 %

Climate change	Application of the central (+20%) and upper end (+40%) allowances for potential change anticipated for the 2080s in the table above shows the estimated attenuation volumes for the 1% AEP and 3.33% AEP rainfall events.
Surface water: flood risk impacts from development site, mitigation & SuDS	As part of this Level 2 SFRA we have included calculations to provide an estimated land take if a pond with an assumed depth of 1.5m was included as part of the development. Attenuation volumes are presented for the critical storm duration for the 3.33% AEP event with exceedance flows quantified up to the 1% event. To prevent development worsening flood risk elsewhere, surface water runoff must be managed on site.

RES-RA2.1: Land East of Birkenhead Road	
Flood Source: Groundwater	
Flood risk: groundwater	 **Figure 11: Susceptibility of groundwater flooding (BGS national dataset)** Based on geological and hydrogeological information, the BGS dataset can be used to identify areas where geological conditions could enable groundwater flooding to occur and where groundwater may come close to the ground surface. The dataset should not be used on its own to make planning decisions at any scale and should not be used to inform planning decisions at the site scale. The susceptibility data cannot be used on its own to indicate risk of groundwater flooding. The dataset shows that the site is not prone to groundwater flooding.
Overall Site Assessment	
Access and egress	Safe access and egress would not be achievable in the long term due to climate change and current FWAs only cover a small proportion of the site. Escape routes must remain dry at all times therefore raised walkways above a design flood level plus some freeboard would be required. Any FRA for the site must include an Emergency Plan focused on the timely evacuation of site users ahead of any flood event occurring.

RES-RA2.1: Land East of Birkenhead Road	
Recommendation summary	Based on the evidence presented in the Level 1 SFRA and this Level 2 SFRA: - Early discussions should take place with the EA with regards to the tidal flood risk issues on this site. The EA offers early engagement through an advisory service via their website (https://www.gov.uk/guidance/developers-get-environmental-advice-on-your-planning-proposals) or by emailing the local office: SPPlanning.RFH@environment-agency.gov.uk. - It is recommended that this site should not be developed for residential use given the significant long-term risk with climate change. The site should remain for less vulnerable uses with resilience measures in place or alternatively left as open space and converted to multifunctional amenity greenspace providing flood storage and social and environmental benefits. - Land raising may be a viable option to protect the site from tidal flooding in the long term. Flood defence measures such as raised bunds should be considered to the north of the site to avoid any adverse impacts to existing residential development. This should be explored at the FRA stage. - Any consideration for development must fully investigate the options presented in this Level 2 SFRA, including for the provision of safe access and egress routes.
Can the second part of the Exception Test be satisfied?	Site not subject to the Exception Test though development may be permitted assuming it can be shown that long term tidal flood risk can be mitigated effectively onsite and included within the site design.
FRA requirements	- For development to proceed, the FRA must show the development can be safe for its lifetime and must not increase risk elsewhere. - The FRA should determine whether the implementation of flood defence measures would be feasible to the north of the site. - Full consideration should be given to the impact development may have on the adjacent sites RES-RA2.2 and RES-RA6.5, including any land raising. - The FRA should include emergency planning procedures with consideration to ensuring safe access and egress routes in times of flood. - Any site-specific work should be carried out in line with the NPPF; FRCC-PPG; Local Plan and LLFA policies; and national and local SuDS policy and guidelines. - Consultation should be carried out with the following, where applicable, the LPA; LLFA; emergency planning officers; EA; UU; the highways authorities; and the emergency services.

Offices at

Coleshill
Doncaster
Dublin
Edinburgh
Exeter
Glasgow
Haywards Heath
Isle of Man
Limerick
Newcastle upon Tyne
Newport
Peterborough
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Wirral Level 2 Strategic Flood Risk Assessment

Site RES-RA2.2

Draft Report

April 2022

www.jbaconsulting.com

WIRRAL

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Revision History

Revision Ref / Date	Amendments	Issued to
V1.0 Draft April 2022	Site RES-RA2.1 split into two	John Entwistle
V2.0 Final April 2022	Council comments addressed	John Entwistle

Prepared by ..... Hannah Bishop BSc MSc

Assistant Analyst

Reviewed by ..... Mike Williamson BSc MSc CGeog FRGS EADA

Principal Flood Risk Analyst

Purpose

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JBA Consulting has no liability regarding the use of this report except to Wirral Council.

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Abbreviations

AOD	Above Ordnance Datum
BGS	British Geological Survey
EA	Environment Agency
FRCC-PPG	Flood Risk and Coastal Change Planning Practice Guidance
FMfP	Flood Map for Planning
FAA	Flood Alert Area
FRA	Flood Risk Assessment
FWA	Flood Warning Area
HFM	Historic Flood Map
LIDAR	Light Detection and Radar
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
NPPF	National Planning Policy Framework
RFM	Reservoir Flood Map
RoFSW	Risk of Flooding from Surface Water
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Drainage Systems
UU	United Utilities
WFD	Water Framework Directive

RES-RA2.2: Land East of Birkenhead Road	
Location	Land East of Birkenhead Road, Seacombe (South)
Site area (ha)	1.58
Watercourse	The Birket/East Float
EA Model used	Mersey Estuary 2018 (includes tidal Birket)
Existing use	Industrial and brownfield
Existing site flood risk vulnerability classification (NPPF)	Less vulnerable
Proposed use	Residential
Proposed development flood risk vulnerability classification (NPPF)	More vulnerable
Proposed development impermeable area (ha)	1.34

RES-RA2.2: Land East of Birkenhead Road

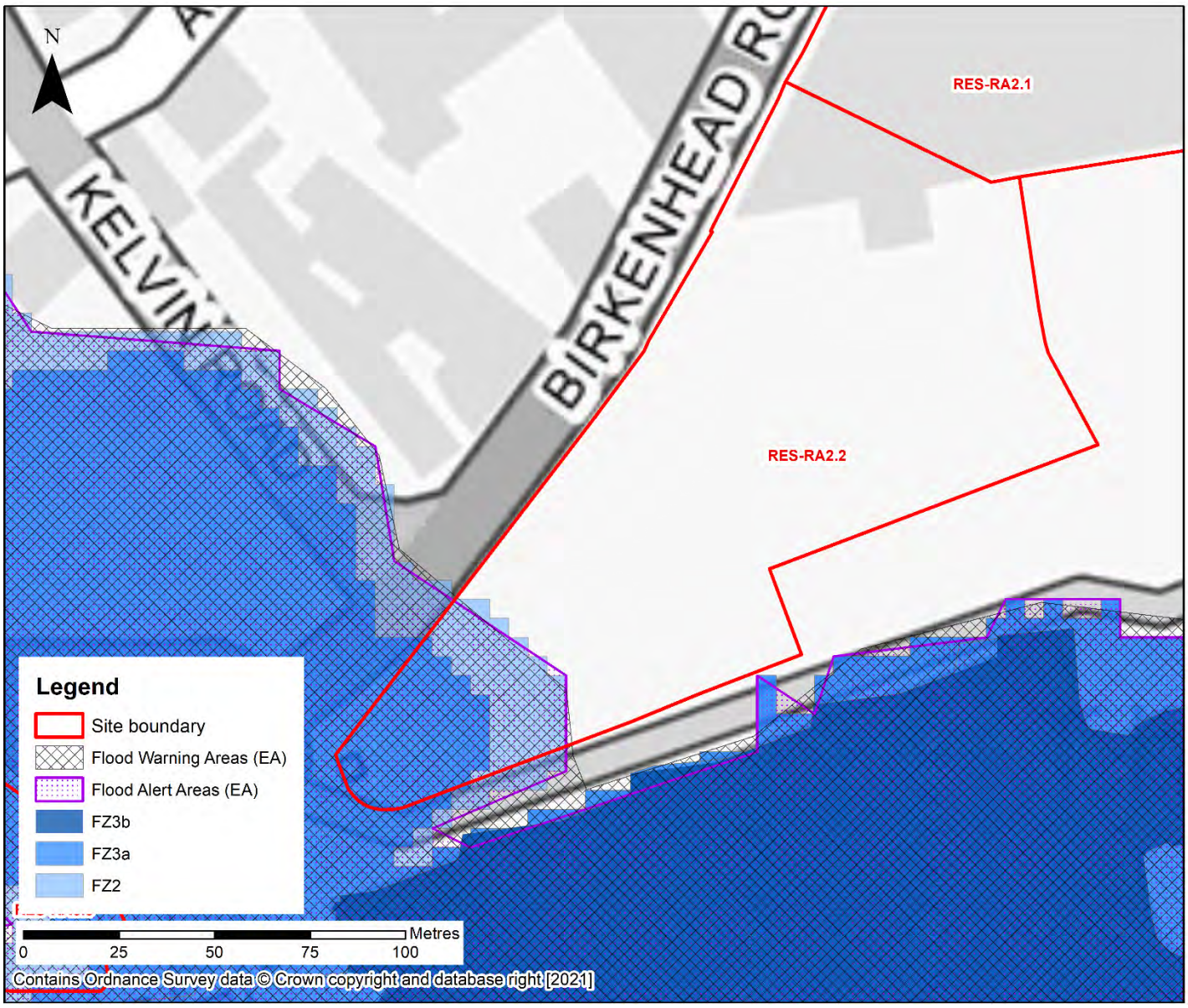


Figure 1: Existing tidal and fluvial flood zones, and flood risk data

The Main River The Birket flows eastwards past the southern boundary of the site before exiting into the Mersey Estuary. The south west corner of the site is within fluvial Flood Zone 3a with the majority of the site within Flood Zone 1, according to the Flood Map for Planning. The EA has confirmed that the risk in this area is dominated by tidal risk and fluvial risk is very low. It is likely the Flood Map for Planning will be updated in due course to reflect this. The Flood Zone 2 area is covered by a FWA and a FAA. The Shoreline Management Plan policy in place for this stretch of coastline is 'hold the line'.

RES-RA2.2: Land East of Birkenhead Road

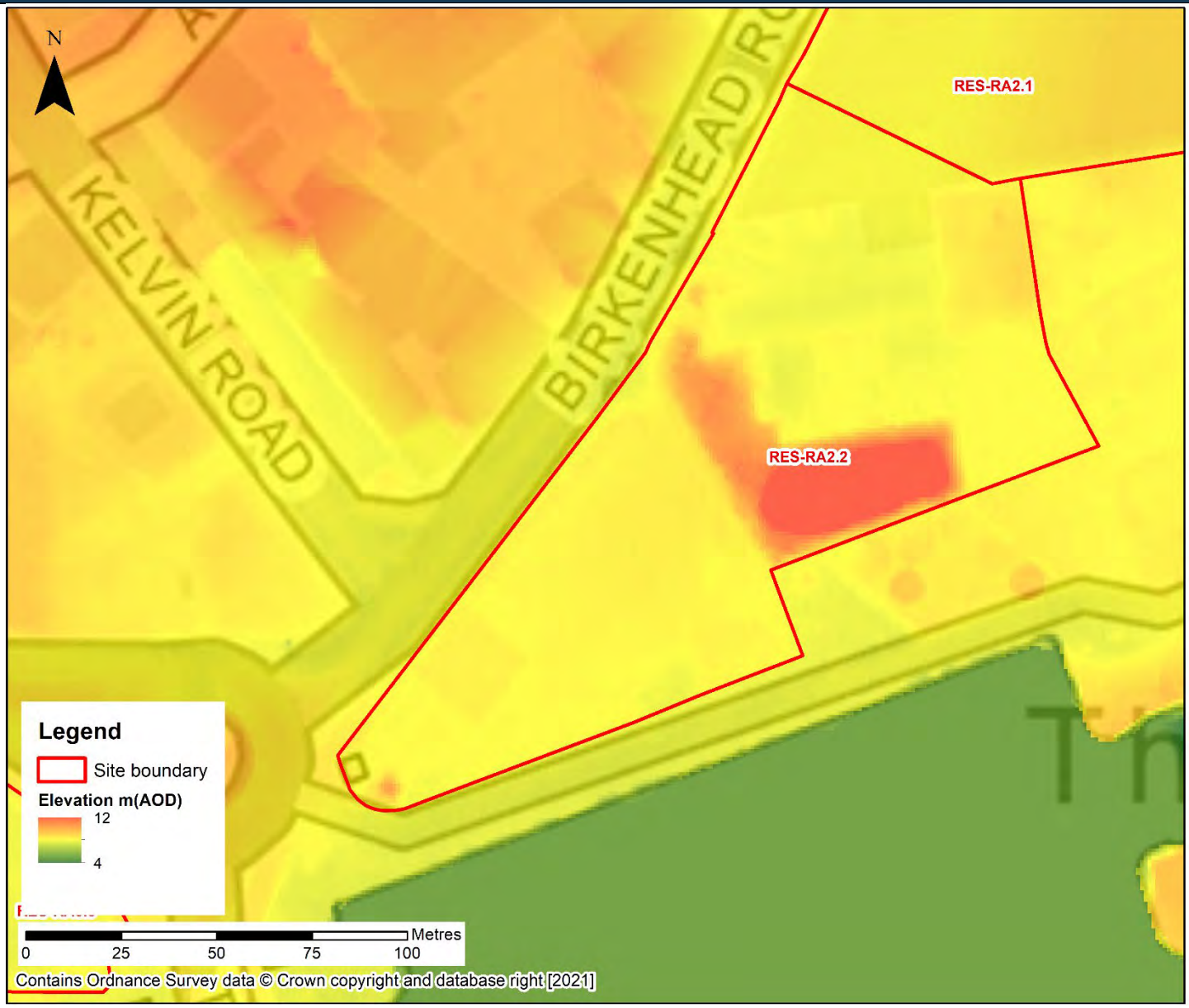
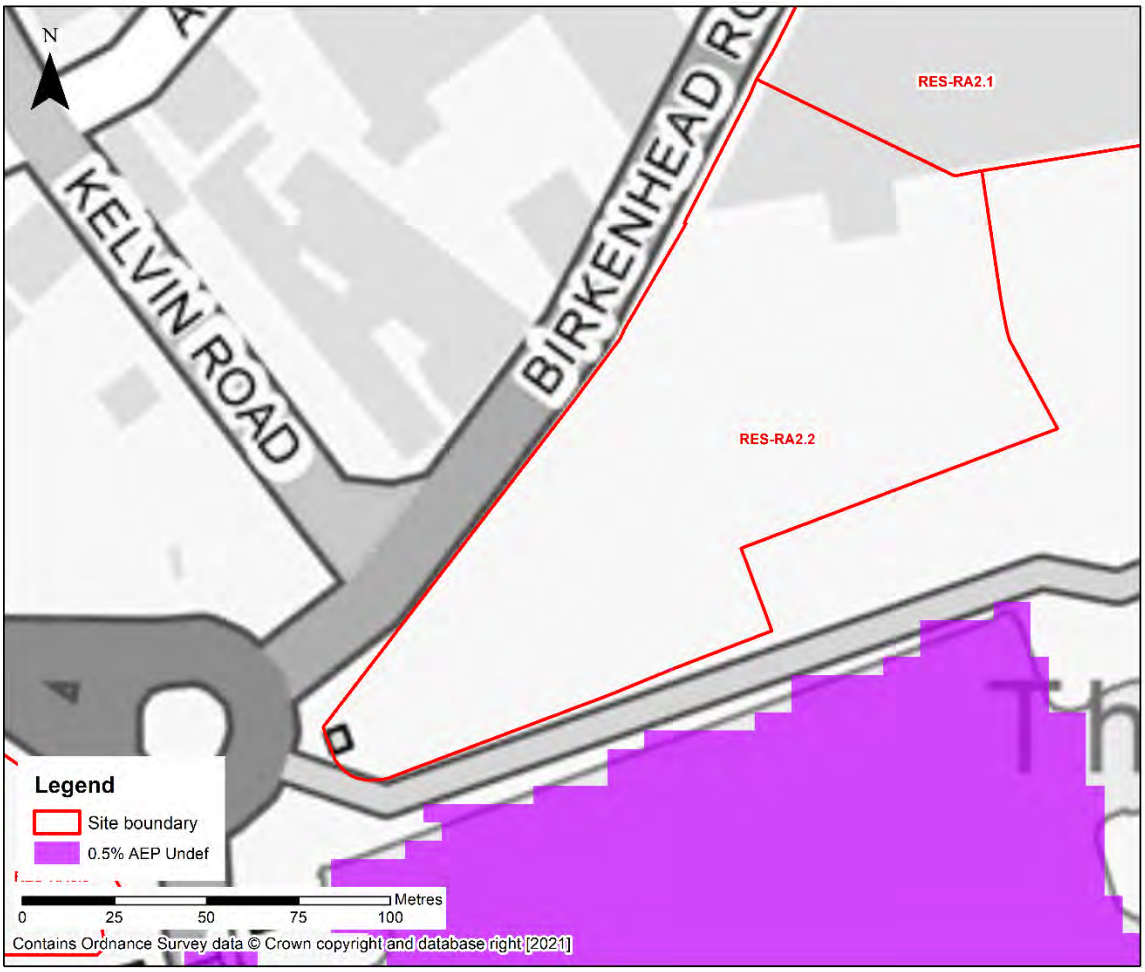


Figure 2: Topography

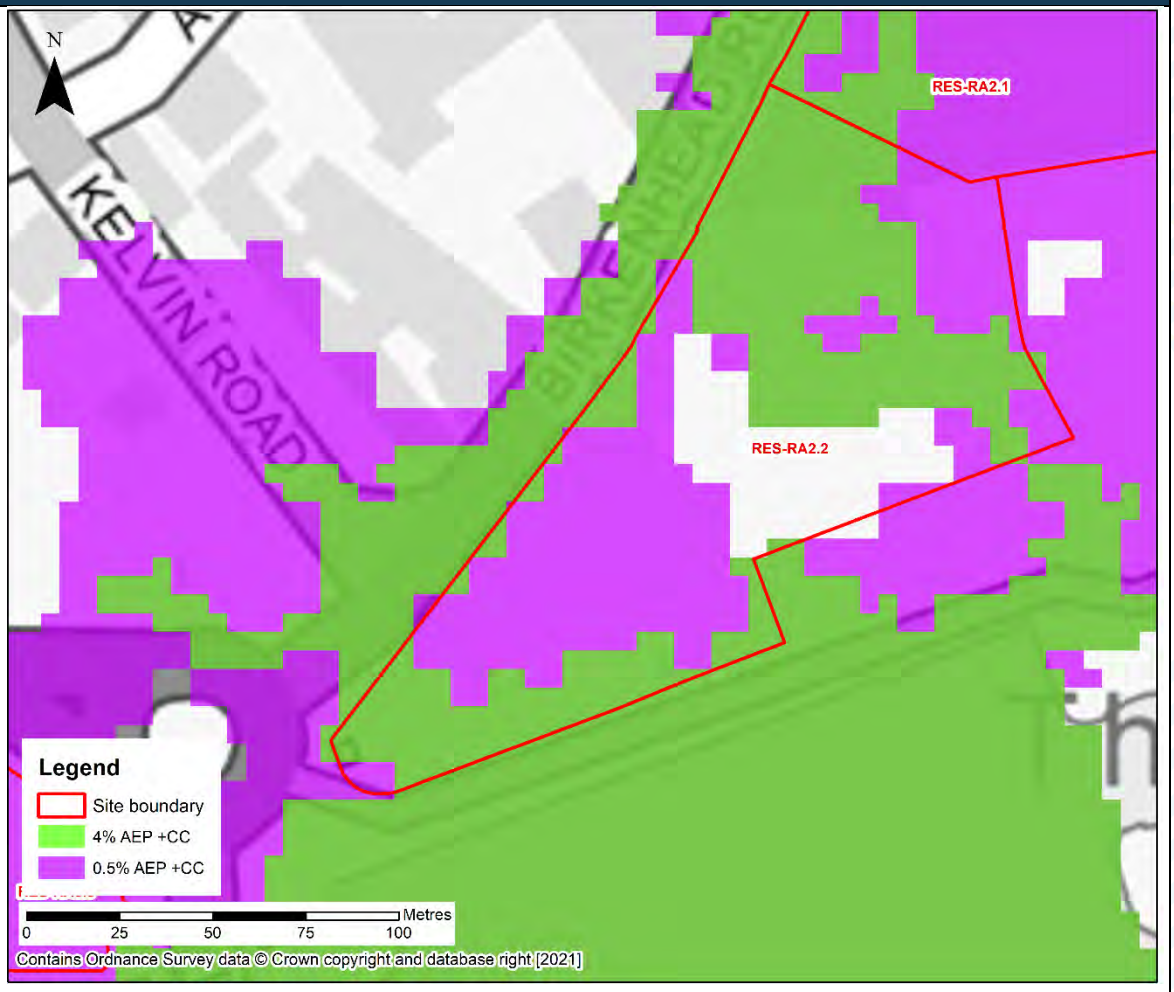
The elevation across the site predominantly remains the same at around 7 mAOD with the exception of a small area in the centre of the site where the elevation is higher ranging between 9 and 12 mAOD. This area appears to be a grassed area within the industrial overall site.

Flood Source: Tidal

Flood Zones	Flood Zone 3b	Flood Zone 3b +climate change*	Flood Zone 3a	Flood Zone 3a +climate change*	Flood Zone 2
	0%	+45.4%	0%	+86.5%	0%
Tidal: maximum depth	Not available	0.2 m	N/A	0.72 m	Not available
Flood Zone 3b figures stated based on defended model; Flood Zone 3a and 2 figures stated based on undefended model					

RES-RA2.2: Land East of Birkenhead Road	
*Climate change figures based on 70th percentile (higher central allowance)	
Modelled tidal risk including climate change (Mersey Estuary 2018 model) NOTE: modelled outputs for this SFRA are subtly different to original 2018 modelled outputs due to upgraded modelling and GIS software	 **Figure 3: modelled tidal flood outline for present day 0.5% AEP event** NOTE: the modelling outputs presented at this site are from the Mersey Estuary 2018 coastal model only. Although Flood Zone 3 (Figure 1) on the site is stated as fluvial, the modelled outputs are tidal only, hence the difference in Flood Zone 3a in Figure 1 and the modelled tidal 0.5% AEP event outline shown above in Figure 3. However, the risk to the site in the long term is dominated by tidal flooding, as shown in Figure 4 below. The EA has also confirmed that fluvial risk in this area is very low

RES-RA2.2: Land East of Birkenhead Road



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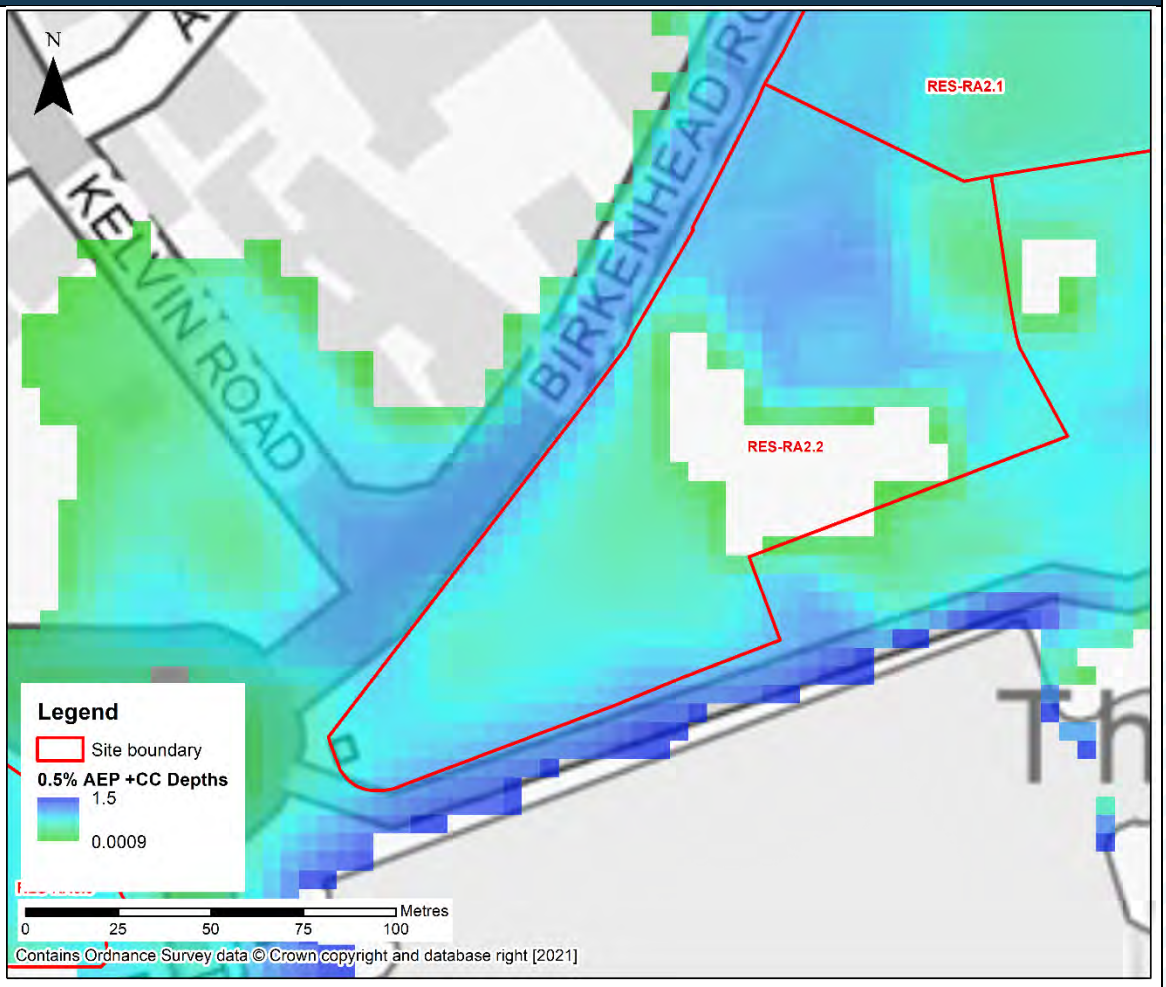
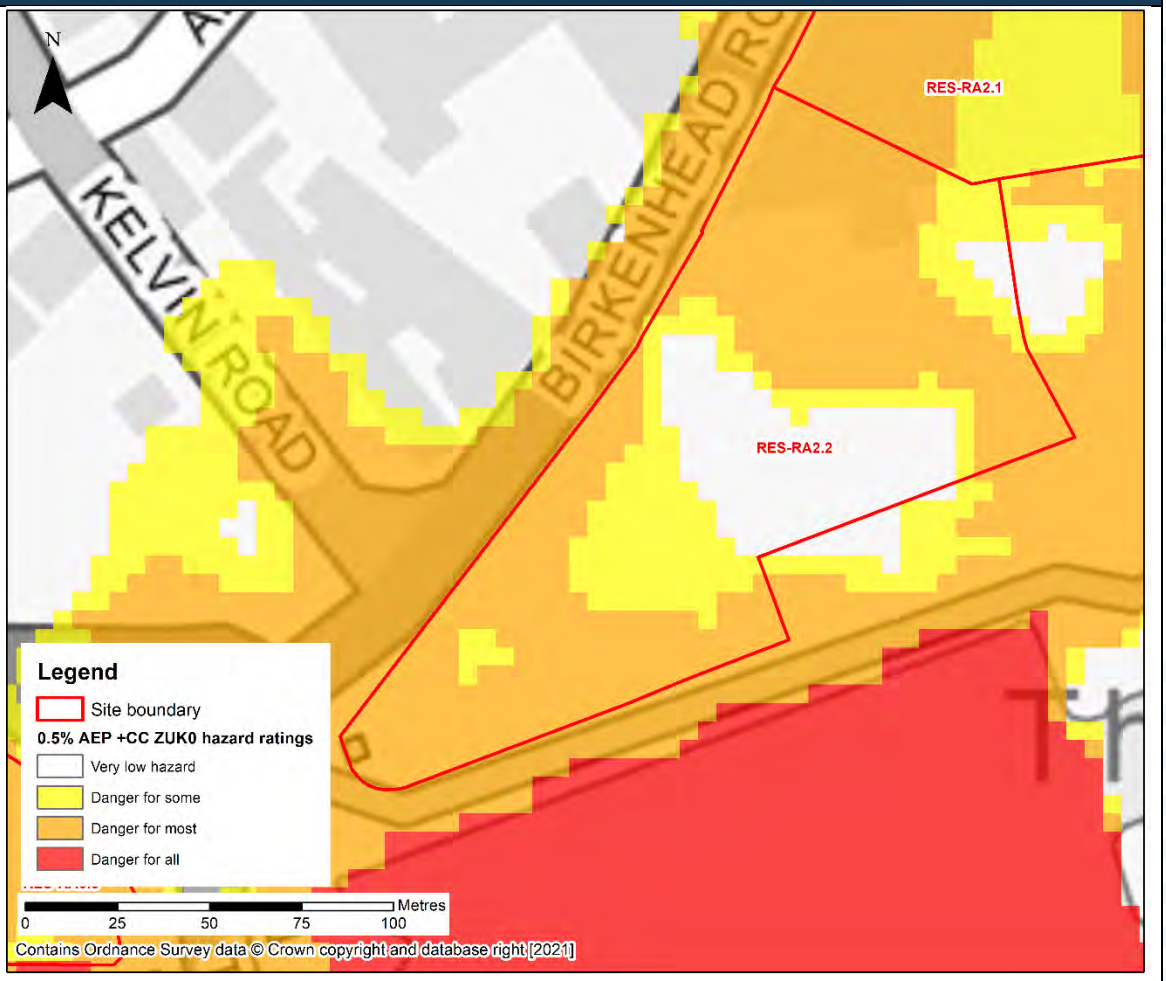


Figure 5: modelled tidal flood depths for 0.5% AEP + climate change event

Note: depth grid erased from open water to provide more accurate representation of flood depths onsite

RES-RA2.2: Land East of Birkenhead Road	
	 **Figure 6: modelled tidal flood hazard for 0.5% AEP +climate change event** **Tidal hazard ratings based on Table 4 of the SUPPLEMENTARY NOTE ON FLOOD HAZARD RATINGS AND THRESHOLDS FOR DEVELOPMENT PLANNING AND CONTROL PURPOSE – Clarification of the Table 13.1 of FD2320/TR2 and Figure 3.2 of FD2321/TR1. May 2008.* It is clear from the above figures that climate change will significantly impact the site in the long term.
Tidal modelling: modelled land raising	
Modelled tidal risk including climate change on the coast with modelled land raising (Mersey Estuary 2018 model)	Given the significant risk exhibited at this site when accounting for climate change, it was considered necessary to model land raising of the site as a potential mitigation technique to gauge the offsite effects of this. A simple approach was applied whereby the whole site was uplifted to a set value to ensure the whole site was raised out of the flood zone. In reality, the terrain would be gently regraded and reformed to direct displaced water to, most likely, the adjacent Mersey Estuary. Any FRA for the site should assess this further once site layout options are established. It should be noted that modelled outputs represent land raising at both this site

and sites RES-RA2.2 and RES-RA6.5. Therefore, any decisions made to raise the land at this site should be considered with land raising at the adjacent sites RES-RA2.2 and RES-RA6.5.

The elevation of the site was uplifted by 1.45 m to reflect the maximum levels for the 0.5% + CC (higher central) event +600 mm freeboard, as recommended by the EA. The updated maximum elevation within the site boundary therefore increased to 13.59 mAOD. Figure 7 shows the entire site to be flood free when compared to the baseline 0.5% AEP +CC extent in Figure 4.

As a result of land raising, modelled depths around the majority of the site have decreased compared to the baseline climate change event. This is beneficial to the residential development located around Harlech Street, where depths are around 20mm lower. Depths to the east of the site are modelled to increase by around 20mm compared to the baseline event.

The observed decrease in depths to the south and west are likely to have occurred as a result of floodwaters inundating the north and east of the site first from the estuary and forcing displaced floodwater to be constrained in the area east of the site.

Hazard ratings in the area surrounding the site remain largely similar, with some areas having a reduced hazard rating.

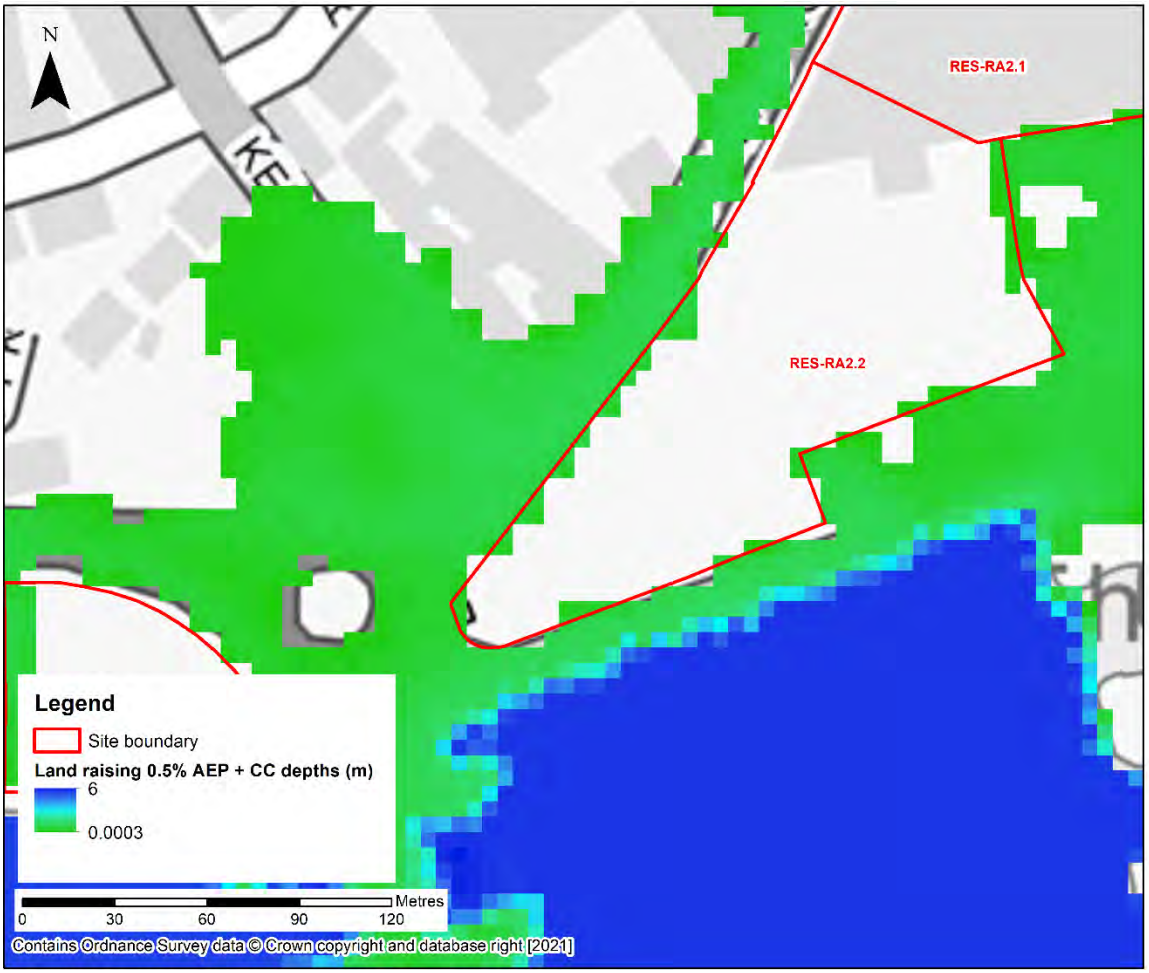


Figure 7: modelled tidal depths for the 0.5% AEP plus climate change land raising scenario

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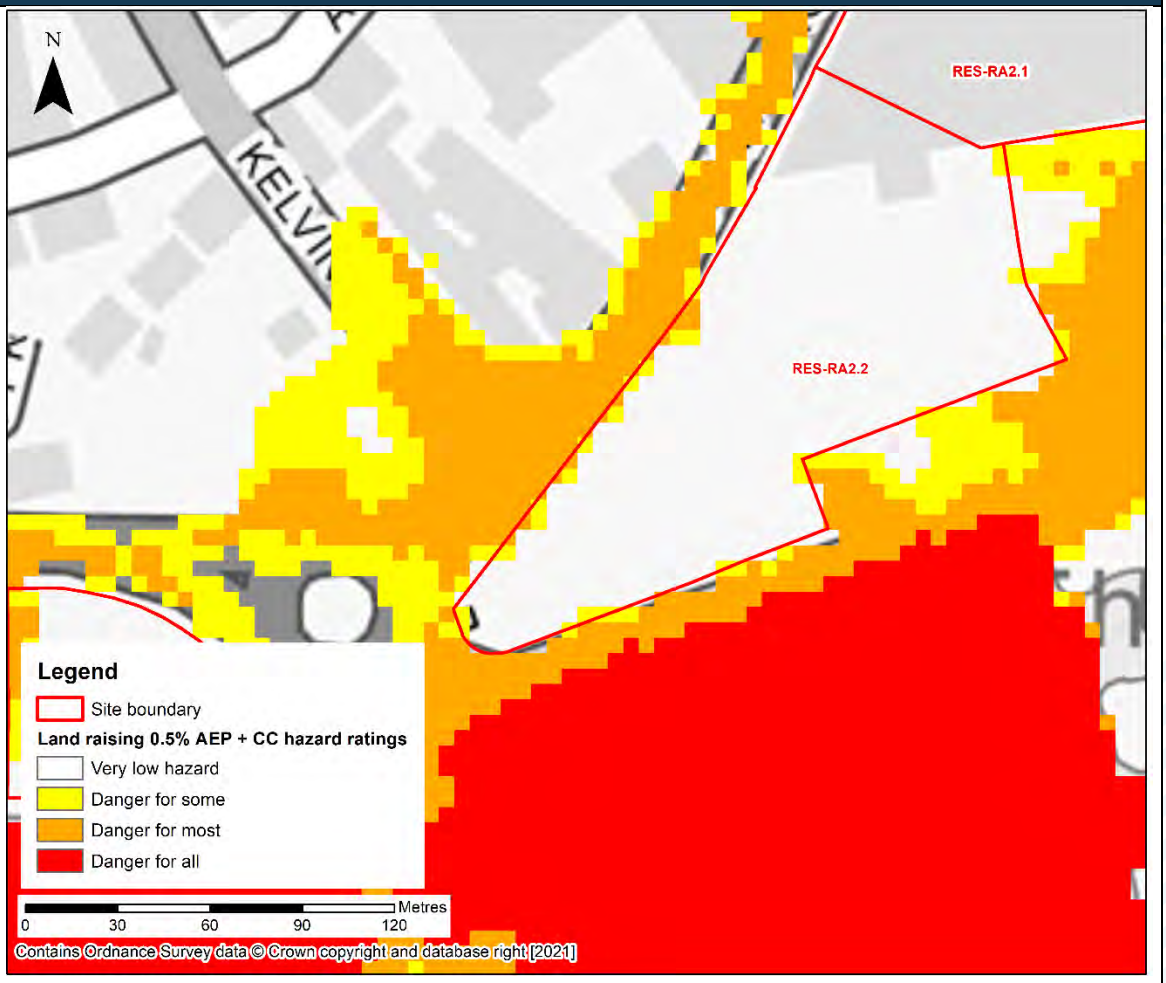
	 **Figure 8: modelled tidal hazards for the 0.5% AEP plus climate change land raising scenario**
Historic flooding	There are no areas of historic flooding that affect the site according to the EA's Historic Flood Map (HFM) dataset.
Defences	There is no known flood defence infrastructure in the vicinity of the site.
Flood Warning Area	According to the EA's FWA dataset, there is a FWA in operation in the south-west corner of the site for the Irish Sea and Mersey Estuary from the Head of the Wirral to Runcorn with areas at risk including parts of Hoylake, Meols, Moreton and Wallasey.
Natural Flood Management / Working with Natural Process	The site lies outside the national scale 'potential for WwNP dataset'.
Observations, mitigation options & site suitability: tidal	- The proposed use of development would see a change in risk classification from less vulnerable to more vulnerable according to the NPPF. - Given the change in use and therefore vulnerability of the site, 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 change of use meets the objectives of the

RES-RA2.2: Land East of Birkenhead Road	
	Framework'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). - The site is at significant long term tidal risk from climate change. The whole site is at risk from the 0.5% AEP event plus climate change to a maximum depth of 0.72 m with a Danger for Most hazard rating. - The functional floodplain could be significantly extended across the site in future, as shown by the 4% AEP event plus climate change outline in Figure 3. - Given the modelled risk from climate change and the difficulties with access and egress routes, it is recommended this site should not be developed for residential use. Ideally, this site would remain for less vulnerable uses with appropriate resilience measures put in place or be used as a multifunctional greenspace for flood storage, amenity use and to provide environmental/ecological benefits - Safe access and egress routes must be available at all times of flooding. All surrounding access routes are classified as 'danger for most' in the long terms making the provision for escape routes challenging. Any access routes would have to be raised above the 0.5% AEP event +climate change maximum level. A FWA is in place however which should provide advanced warning for site users to evacuate ahead of a flood event. - The modelled land raising scenario indicates raising the levels of the site to the 0.5% AEP +CC maximum level, plus 600mm freeboard, would protect the site from tidal flooding in the long term. Depths to the area surrounding the site have decreased. - Although land raising would be a viable option in protecting the site from tidal flooding, access and egress routes would still need to be available during times of flood, therefore raised escape route options should be investigated. - Stilted development may be an option though is likely to be an expensive design solution with access and egress routes also required to be above the design flood level. - A further option may be for ground floor parking or other less vulnerable uses (i.e. non-residential such as shops, restaurants, offices) and for habitable dwellings to be situated on first floor and upwards. However, safe access and egress routes must be available at times of flood, even for above ground floor accommodation. - The SMP policy along the stretch of coast affecting the site is to Hold the Line, therefore the long-term strategy is for the current modelled flood risk to remain and not be exacerbated. - A flood risk activity permit may be required if the development of the site is within 16 metres of the tidally influenced Birket Main River. Details on obtaining a Flood Risk Activity Permit are available from the EA. Also, the EA advises against development within 8m of any watercourse to enable access for maintenance works. - Were development of this site to proceed, given the proximity of this site to the neighbouring RES-RA2.1 and RES-RA6.5, it would be prudent to formulate a strategy to develop these sites in tandem and for consultation between each developer to take place to ensure a joined-up approach for sustainable development is in place, with consideration to the strategic solutions outlined in the Level 2 SFRA Summary Report.

RES-RA2.2: Land East of Birkenhead Road			
Flood source: infrastructure failure – reservoirs (residual)			
Flood risk: reservoir	There is no risk of flooding to the site as a result of dam failure, according to the EA's online RFM.		
Flood source: infrastructure failure – canals (residual)			
Flood risk: canal	There are no canals in the vicinity of the site.		
Flood source: surface water			
Surface Water Flood Risk to Proposed Development Site			
Current site: Risk of Flooding from Surface Water map	High Risk (3.3% AEP event)	Medium Risk (1% AEP event)	Low Risk (0.1% AEP event)
	0.001%	1.3%	14.7%
Surface water max flood depths	0.15 – 0.3 m	0.15 – 0.3 m	0.3 – 0.6 m

RES-RA2.2: Land East of Birkenhead Road

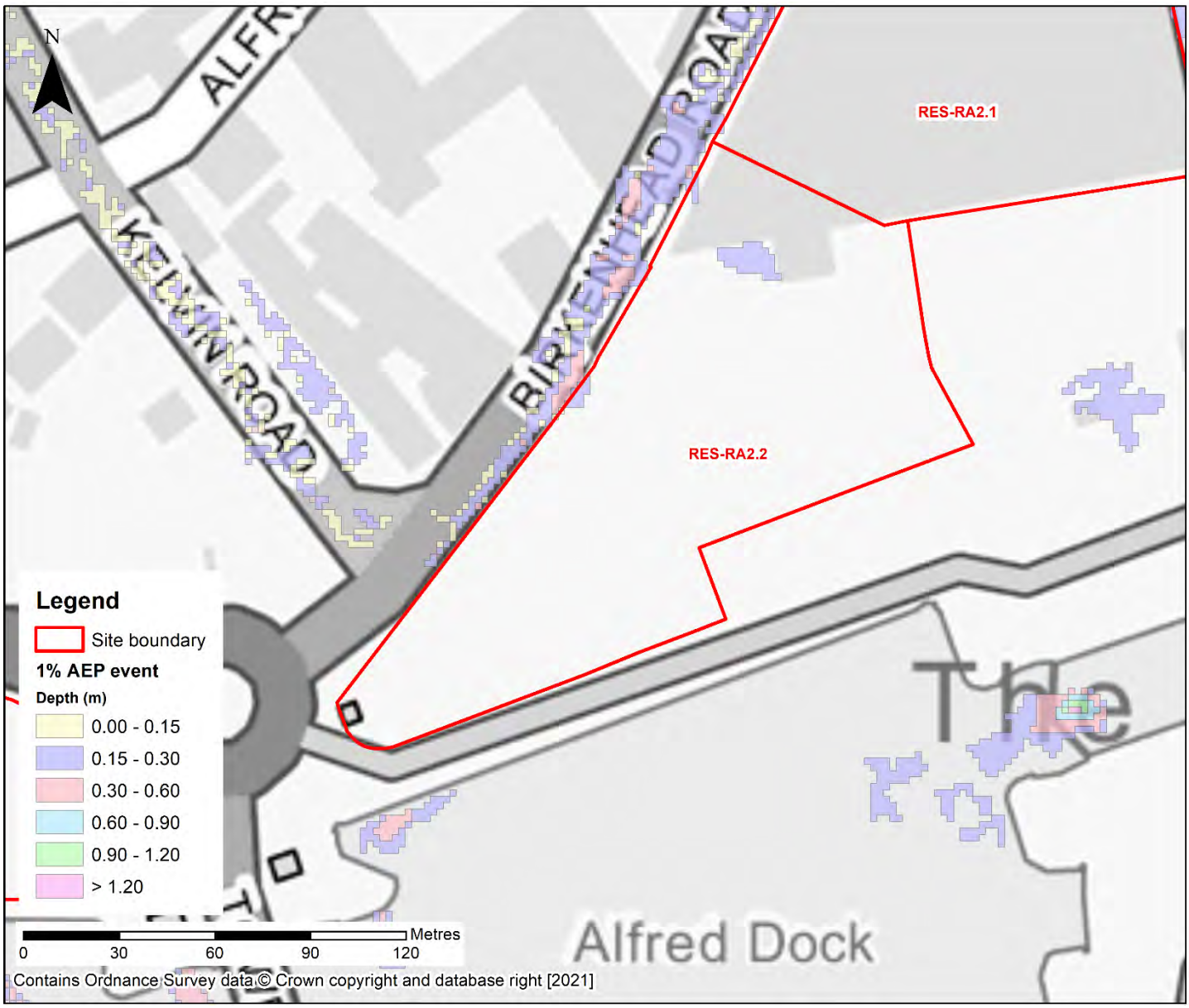


Figure 9: 1% AEP event surface water flood depths (Risk of Flooding from Surface Water map)

RES-RA2.2: Land East of Birkenhead Road

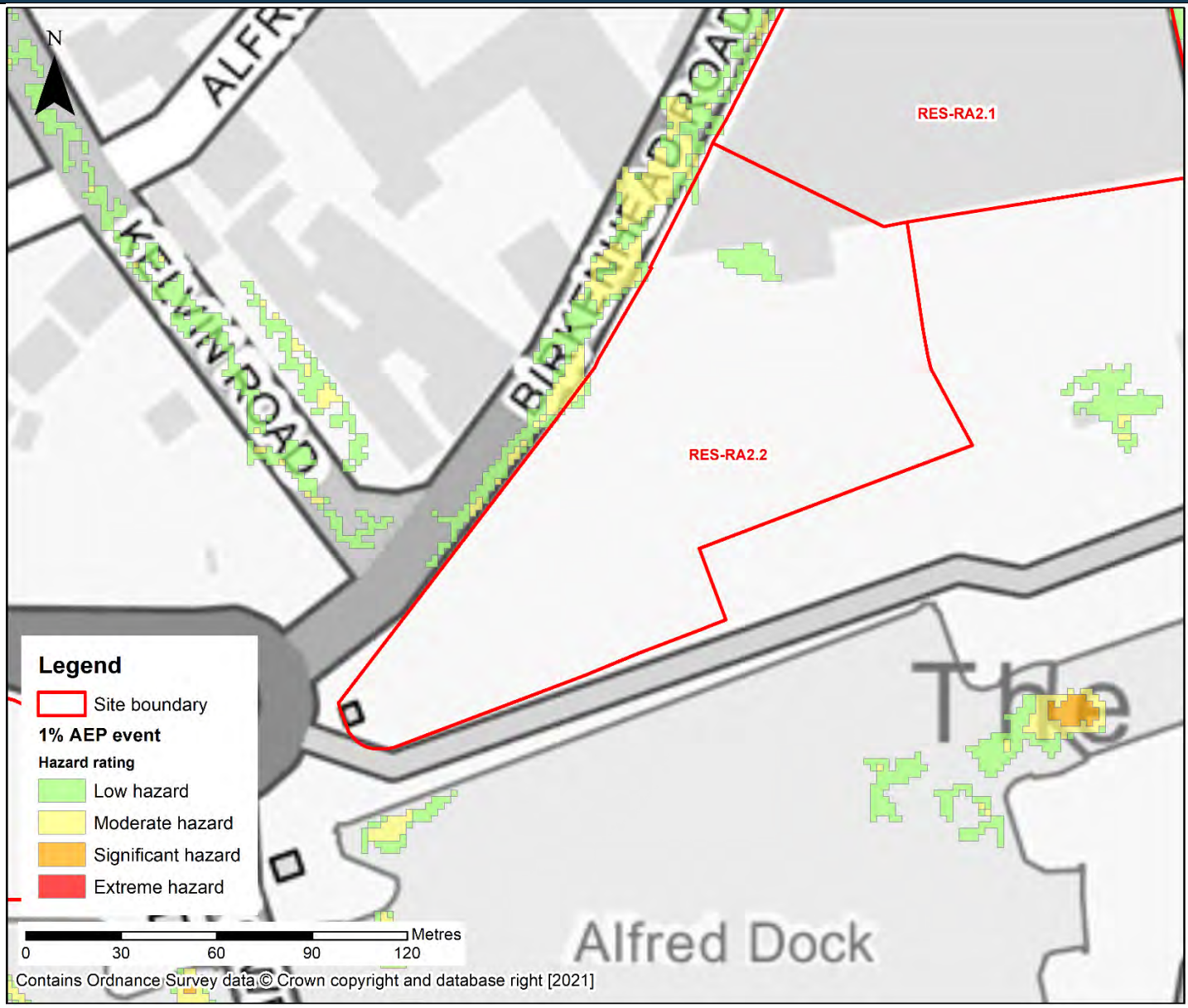


Figure 10: 1% AEP event surface water flood hazards (Risk of Flooding from Surface Water map)

**Surface water hazard rating based on Table 4.2 Hazard to People as a Function of Velocity and Depth, R&D OUTPUTS: FLOOD RISKS TO PEOPLE: PHASE 2 FD2321/TR2. Defra. March 2006.*

Surface water flood risk to development site	There is nominal risk to the site from surface water. Safe access and egress would be achievable via the south of the site
Climate change	The current day 0.1% AEP event outline provides an indication of the likely increase in extent of the more frequent events. The 0.1% AEP event outline covers approximately 15% of the total site area and the extent is constrained by the existing building to the north of the site. The small unnamed road in the south of the site remains free from inundation during the 0.1% AEP event and therefore would still be viable for safe site access

and egress. Birkenhead Road becomes more inundated during the 0.1% AEP event to a maximum depth of between 0.3 and 0.6 m therefore leaving this access and egress route potentially unsafe.

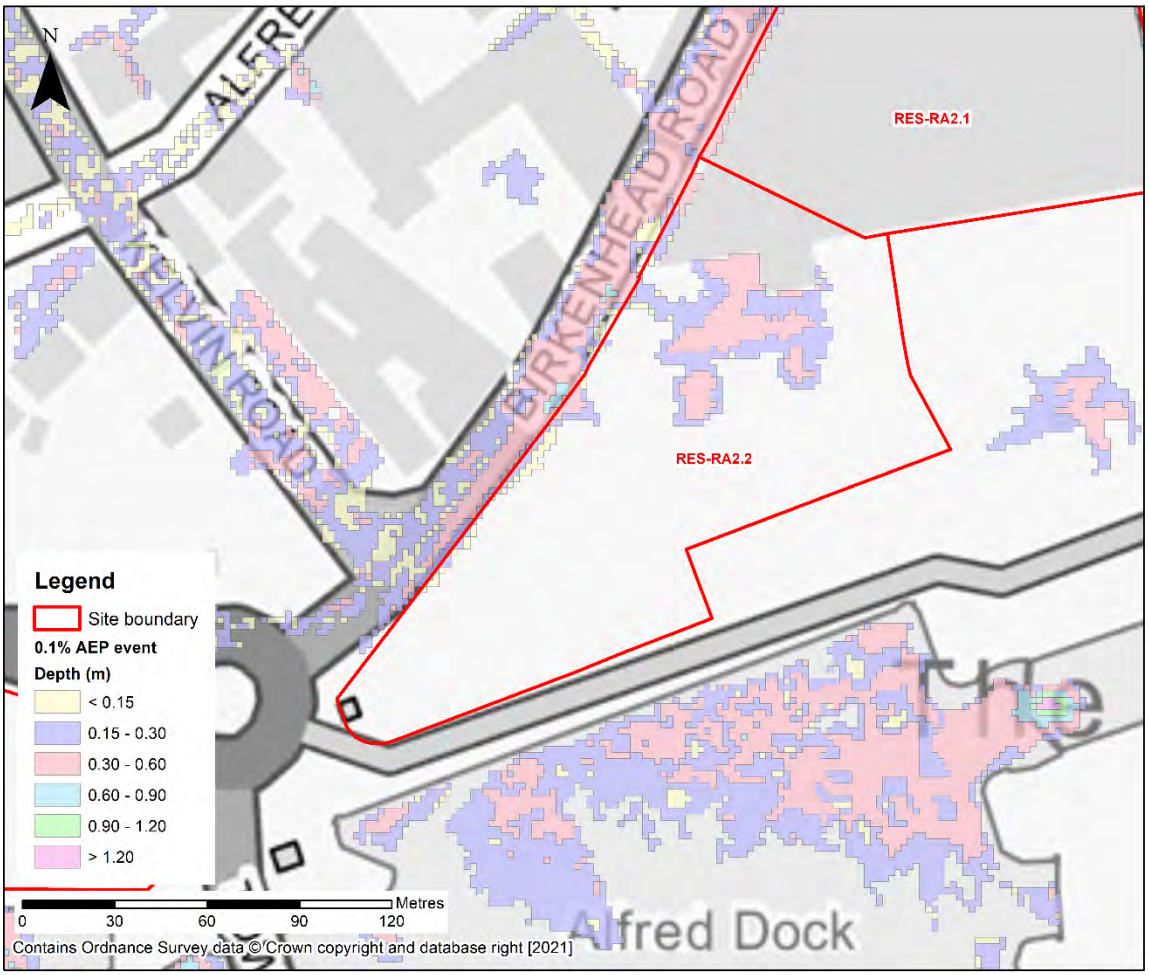
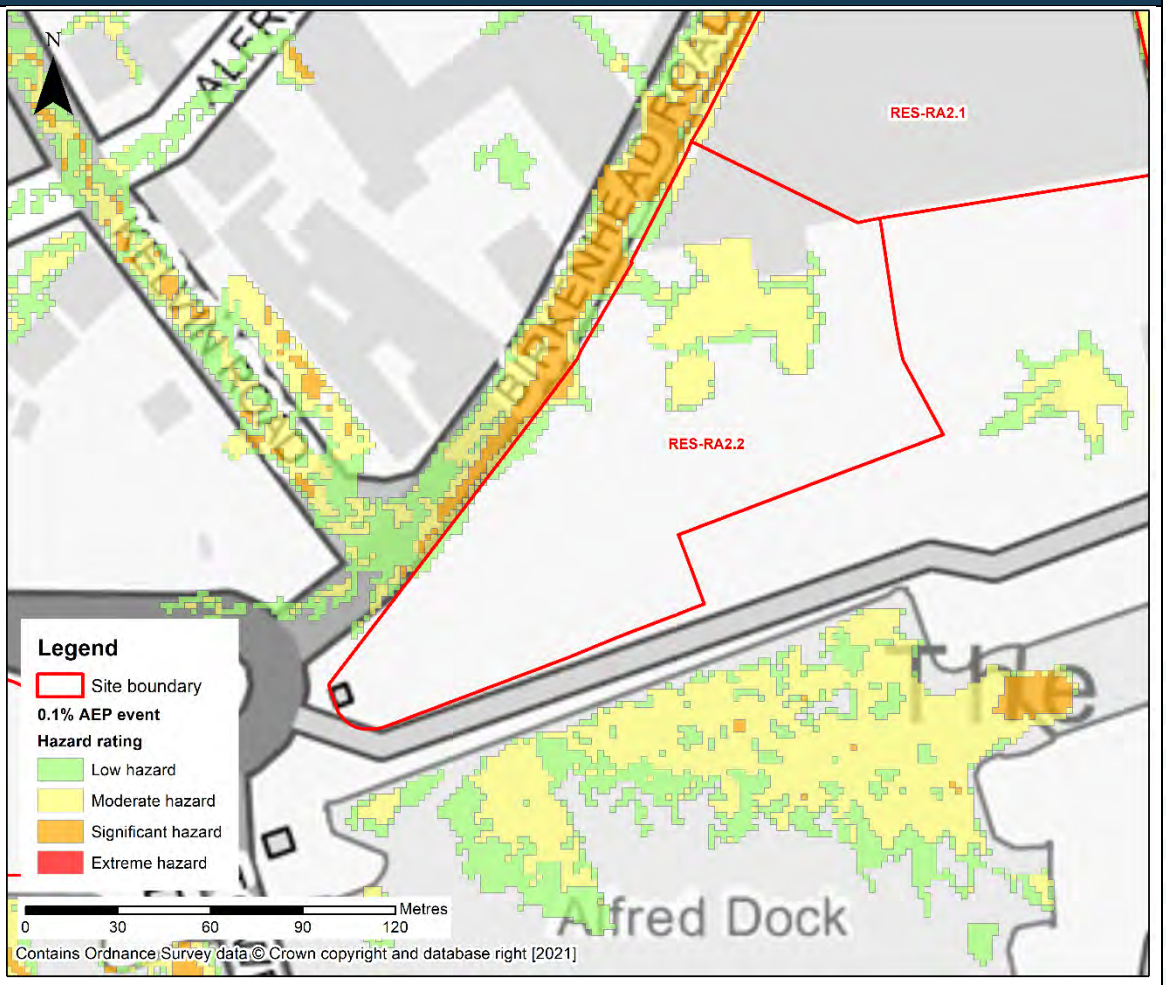
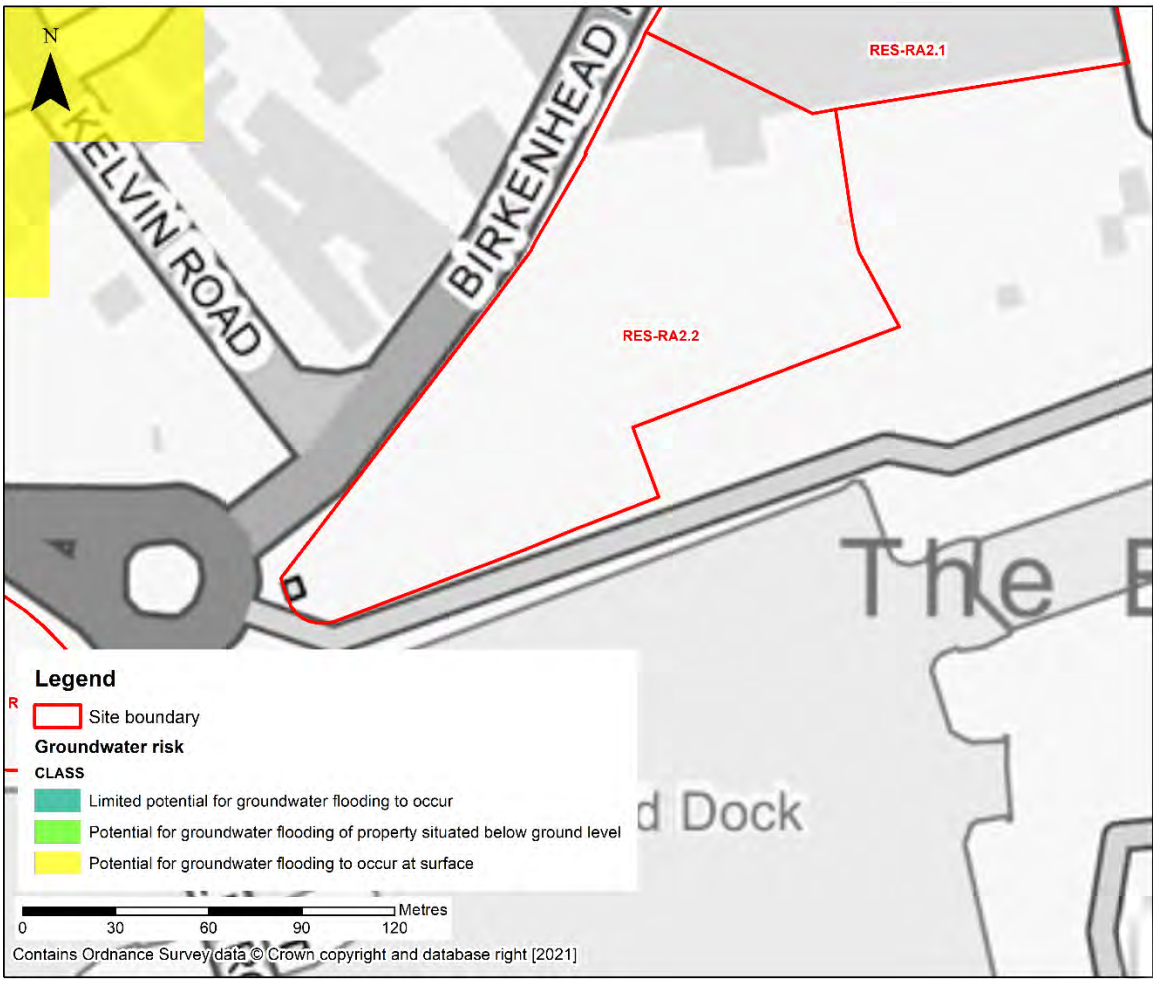


Figure 11: 0.1% AEP event surface water flood depths (Risk of Flooding from Surface Water map)

RES-RA2.2: Land East of Birkenhead Road	
	 **Figure 12: 0.1% AEP event surface water flood hazards (Risk of Flooding from Surface Water map)**
Observations, mitigation options & site suitability: surface water	- Surface water flow modelling of the site should be carried out to ascertain natural flow paths without the current buildings in place. Flow paths and storage areas could then be built into the design of the site at an early stage. - Assessment of the current drainage system in place should be carried out to ascertain any current capacity issues and whether the current system could accommodate the planned residential development or whether further capacity will be required. - A full drainage strategy would be required to ensure there is no increase in surface water flood risk elsewhere as a result of new development. This will require surface water modelling based on proposed layout plans. Consultation with the LLFA should be carried out on surface water drainage arrangements.

RES-RA2.2: Land East of Birkenhead Road						
Surface Water Flood Risk from Proposed Development						
Runoff rates should not exceed current rates and if possible, betterment of existing rates should be aimed for. For the purposes of this assessment, the required volumes of attenuation have been calculated below based on an assumed 85% impermeable area and limiting greenfield runoff rate of Qbar (l/s).						
Proposed development limiting runoff rate: (l/sec) Qbar: 21.49 l/s (FEH Statistical) Q30: 36.54 l/s Q100: 44.70 l/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
30yr Rainfall+20%	7	1785	379	1406	25.9	0.094 ha 2.618 %
30yr Rainfall+40%	8.5	2171	460	1710	31.5	0.114 ha 3.184 %
100yr Rainfall+20%	8.25	2487	447	2040 (634 exceedance storage)	37.6	0.136 ha 3.799 %
100yr Rainfall+40%	9.5	2976	514	2462 (752 exceedance storage)	45.3	0.164 ha 4.585 %
Climate change	Application of the central (+20%) and upper end (+40%) allowances for potential change anticipated for the 2080s in the table above shows the estimated attenuation volumes for the 1% AEP and 3.33% AEP rainfall events.					
Surface water: flood risk impacts from development site, mitigation & SuDS	As part of this Level 2 SFRA we have included calculations to provide an estimated land take if a pond with an assumed depth of 1.5m was included as part of the development. Attenuation volumes are presented for the critical storm duration for the 3.33% AEP event with exceedance flows quantified up to the 1% event. To prevent development worsening flood risk elsewhere, surface water runoff must be managed on site.					

RES-RA2.2: Land East of Birkenhead Road	
Flood Source: Groundwater	
Flood risk: groundwater	 **Figure 13: Susceptibility of groundwater flooding (BGS national dataset)** Based on geological and hydrogeological information, the BGS dataset can be used to identify areas where geological conditions could enable groundwater flooding to occur and where groundwater may come close to the ground surface. The dataset should not be used on its own to make planning decisions at any scale and should not be used to inform planning decisions at the site scale. The susceptibility data cannot be used on its own to indicate risk of groundwater flooding. The dataset shows that the site is not prone to groundwater flooding.
Overall Site Assessment	
Access and egress	Safe access and egress would not be achievable in the long term due to climate change and current FWAs only cover a small proportion of the site. Escape routes must remain dry at all times therefore raised walkways above a design flood level plus some freeboard would be required. Any FRA for the site must include an Emergency Plan focused on the timely evacuation of site users ahead of any flood event occurring.

RES-RA2.2: Land East of Birkenhead Road	
Recommendation summary	Based on the evidence presented in the Level 1 SFRA and this Level 2 SFRA: - Early discussions should take place with the EA with regards to the tidal flood risk issues on this site. The EA offers early engagement through an advisory service via their website (https://www.gov.uk/guidance/developers-get-environmental-advice-on-your-planning-proposals) or by emailing the local office: SPPlanning.RFH@environment-agency.gov.uk. - It is recommended that this site should not be developed for residential use given the significant long-term risk with climate change. The site should remain for less vulnerable uses with resilience measures in place or alternatively left as open space and converted to multifunctional amenity greenspace providing flood storage and social and environmental benefits. - Land raising may be a viable option to protect the site from tidal flooding in the long term. Flood defence measures such as raised bunds should be considered to the north of the site to avoid any adverse impacts to existing residential development. This should be explored at the FRA stage. - Any consideration for development must fully investigate the options presented in this Level 2 SFRA, including for the provision of safe access and egress routes.
Can the second part of the Exception Test be satisfied?	To pass the Exception Test, it must be proven that the site can be safe for its lifetime, which for residential development is 100 years. The climate change modelling in this Level 2 SFRA shows this will not be possible. However, land raising may be a viable option and should be explored further at the FRA stage.
FRA requirements	- For development to proceed, the FRA must show the development can be safe for its lifetime and must not increase risk elsewhere. - The FRA should determine whether the implementation of flood defence measures would be feasible to the north of the site. - Full consideration should be given to the impact development may have on the adjacent sites RES-RA2.1 and RES-RA6.5, including any land raising. - The FRA should include emergency planning procedures with consideration to ensuring safe access and egress routes in times of flood. - Any site-specific work should be carried out in line with the NPPF; FRCC-PPG; Local Plan and LLFA policies; and national and local SuDS policy and guidelines. - Consultation should be carried out with the following, where applicable, the LPA; LLFA; emergency planning officers; EA; UU; the highways authorities; and the emergency services.

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Dublin
Edinburgh
Exeter
Glasgow
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Isle of Man
Limerick
Newcastle upon Tyne
Newport
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Wirral Level 2 Strategic Flood Risk Assessment

Site RES-RA5.1

Draft Report

April 2022

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WIRRAL

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Revision History

Revision Ref / Date	Amendments	Issued to
V1.0 Draft September 2021	-	John Entwistle
V2.0 Draft December 2021	Council and EA comments addressed	John Entwistle
V3.0 Draft April 2022	Site boundary and area extended	John Entwistle

Prepared by ..... Laura Thompson BSc

Assistant Analyst

Reviewed by ..... Mike Williamson BSc MSc CGeog FRGS EADA

Principal Flood Risk Analyst

Purpose

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Abbreviations

AOD	Above Ordnance Datum
BGS	British Geological Survey
EA	Environment Agency
FRCC-PPG	Flood Risk and Coastal Change Planning Practice Guidance
FMfP	Flood Map for Planning
FAA	Flood Alert Area
FRA	Flood Risk Assessment
FWA	Flood Warning Area
HFM	Historic Flood Map
LIDAR	Light Detection and Radar
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
NPPF	National Planning Policy Framework
RFM	Reservoir Flood Map
RoFSW	Risk of Flooding from Surface Water
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Drainage Systems
UU	United Utilities
WFD	Water Framework Directive

RES-RA5.1: SHLAA 4078 Hind street	
Location	Birkenhead
Site area (ha)	15.59
Watercourse	Mersey Estuary
EA Model used	Mersey Estuary 2018 Model
Existing use	Brownfield
Existing site flood risk vulnerability classification (NPPF)	Less vulnerable
Proposed use	Residential
Proposed development flood risk vulnerability classification (NPPF)	More vulnerable
Proposed development impermeable area (ha)	13.25

RES-RA5.1: SHLAA 4078 Hind street

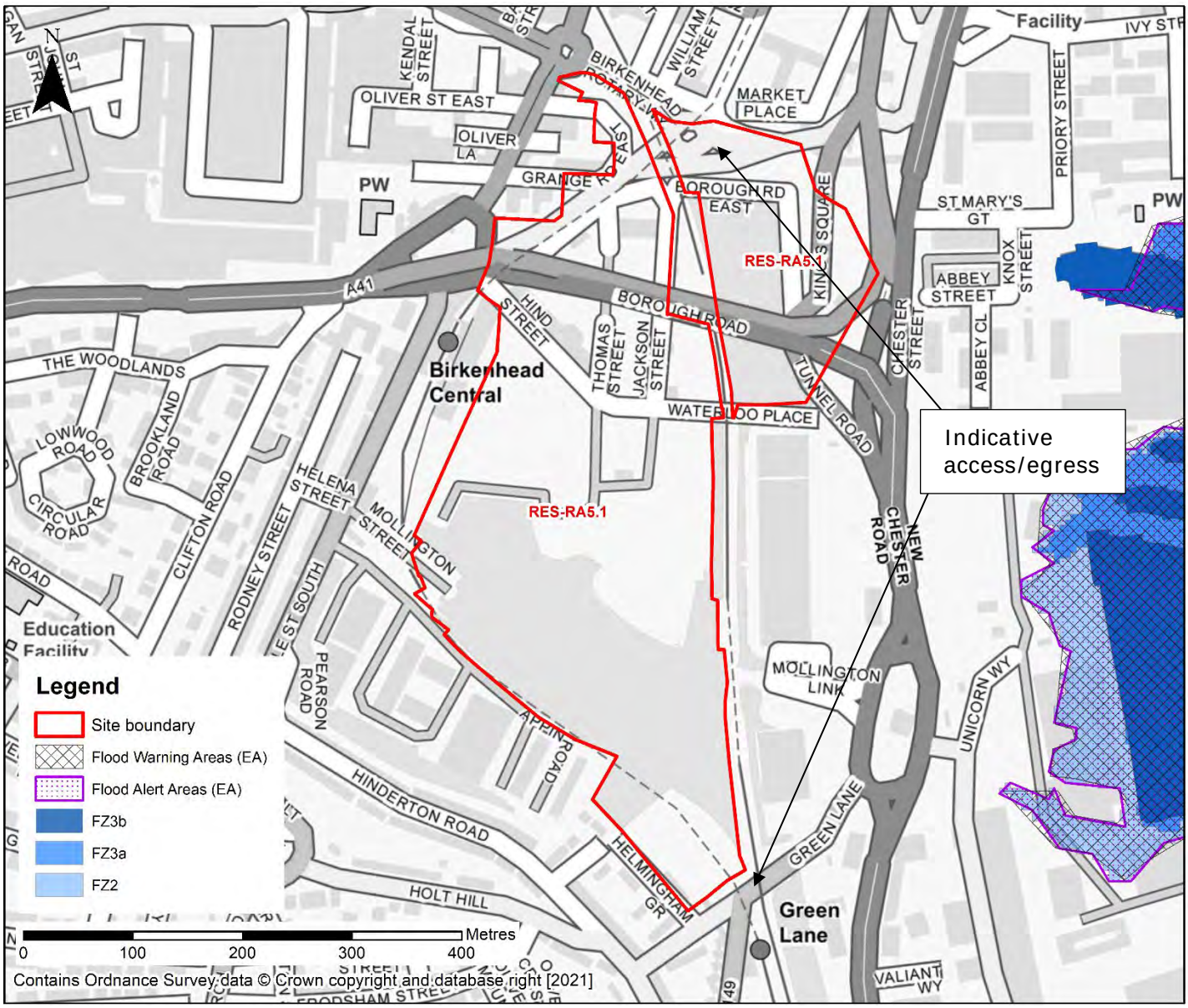


Figure 1: Existing flood zones and flood risk data

The site lies entirely within Flood Zone 1 according the Flood Map for Planning.

RES-RA5.1: SHLAA 4078 Hind street

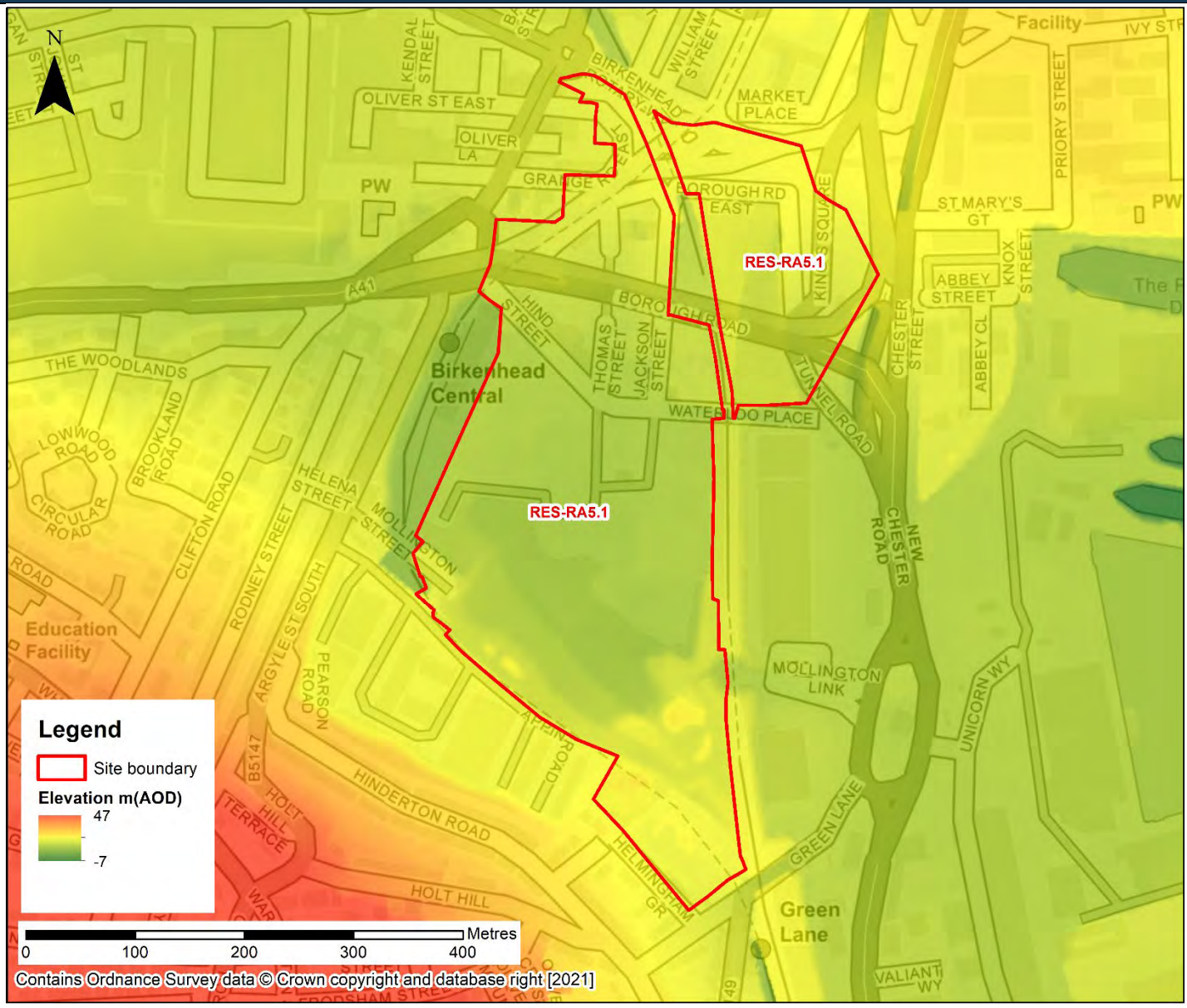


Figure 2: Topography

The elevation varies across the site. The topography generally slopes towards the centre of the site, from higher ground to the south and north at approx. 15 mAOD at the site boundaries down to around 6 mAOD within the centre of the larger parcel of the site.

Flood Zones	Flood Zone 3b	Flood Zone 3b +climate change*	Flood Zone 3a	Flood Zone 3a +climate change*	Flood Zone 2
	0%	+34%	0%	+41%	0%
Tidal: maximum depth	N/A	1.89 m	N/A	2.99 m	N/A

All figures stated based on undefended model
*Climate change figures based on 70th percentile (higher central allowance)

RES-RA5.1: SHLAA 4078 Hind street

Modelled tidal risk including climate change (Mersey Estuary 2018 model)

NOTE: modelled outputs for this SFRA are subtly different to original 2018 modelled outputs due to upgraded modelling and GIS software

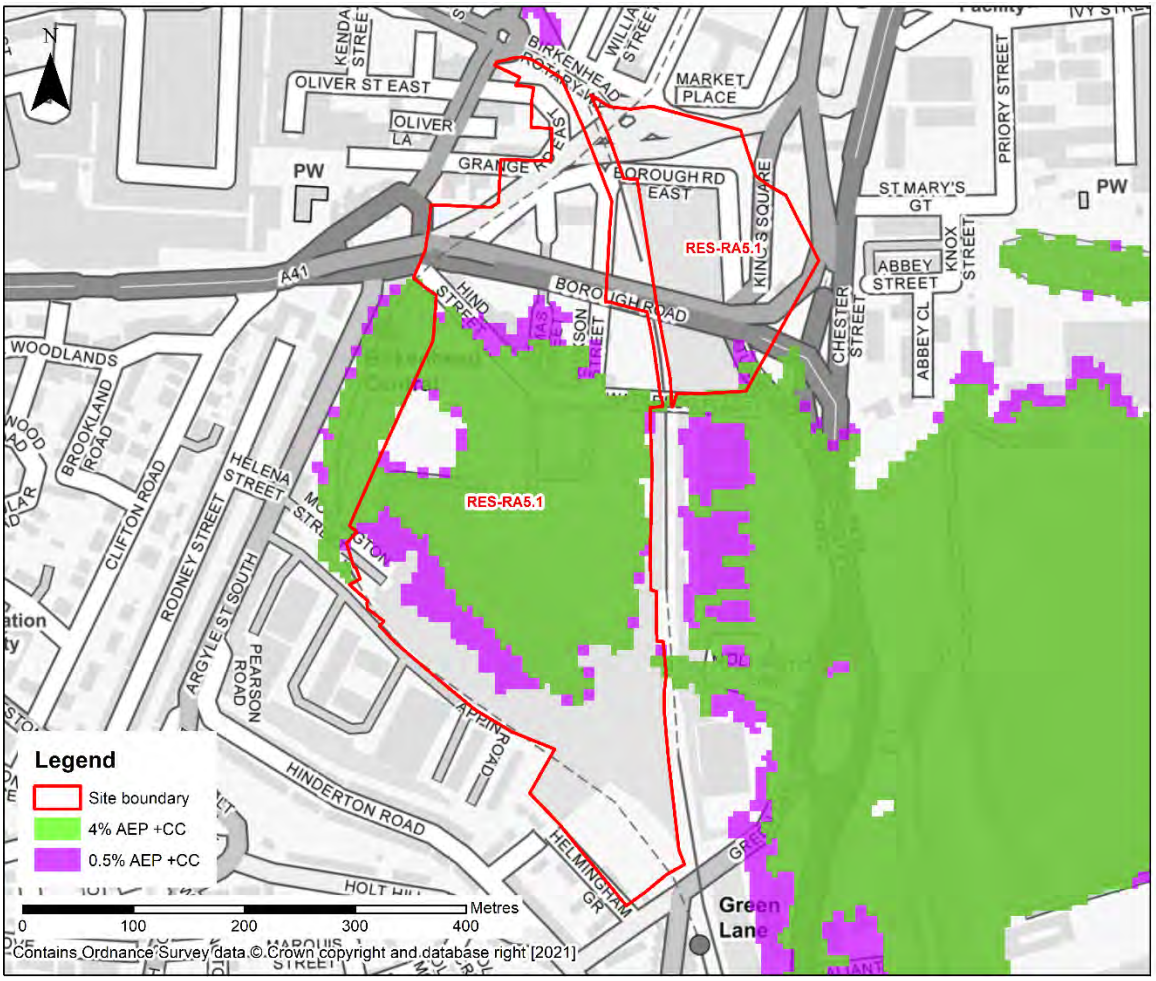


Figure 3: modelled tidal flood outlines for 0.5% AEP plus higher central climate change allowance

Note: Modelled baseline flood extents for the 0.5% AEP event vary from the existing Flood Zone 3a outlines. This is a result of the existing flood zones using the old Coastal Flood Boundaries (CFB) from 2011 and the model having a base year of 2015. The previous CFB excluded data from the Class A gauge at Liverpool due to differences with the surrounding gauges at Heysham and Hilbre Island. The new CFB in 2018 included gauge data from Liverpool and an uplift was added to get the model to a base year of 2021, meaning the levels at the mouth of the estuary increased by over 0.3m causing additional flooding to certain areas.

The current Flood Map for Planning therefore will underestimate present day tidal flood risk to the Wirral hence why the Flood Map for Planning (Figure 1) shows the site to be in Flood Zone 1. The tidal models should be updated with the new CFB data. As more recent data is available which hasn't been built into the flood zones, a precautionary approach should be adopted pending the updating of the tidal models and subsequent updates to the Flood Map for Planning. The tidal models should be updated with the new CFB data.

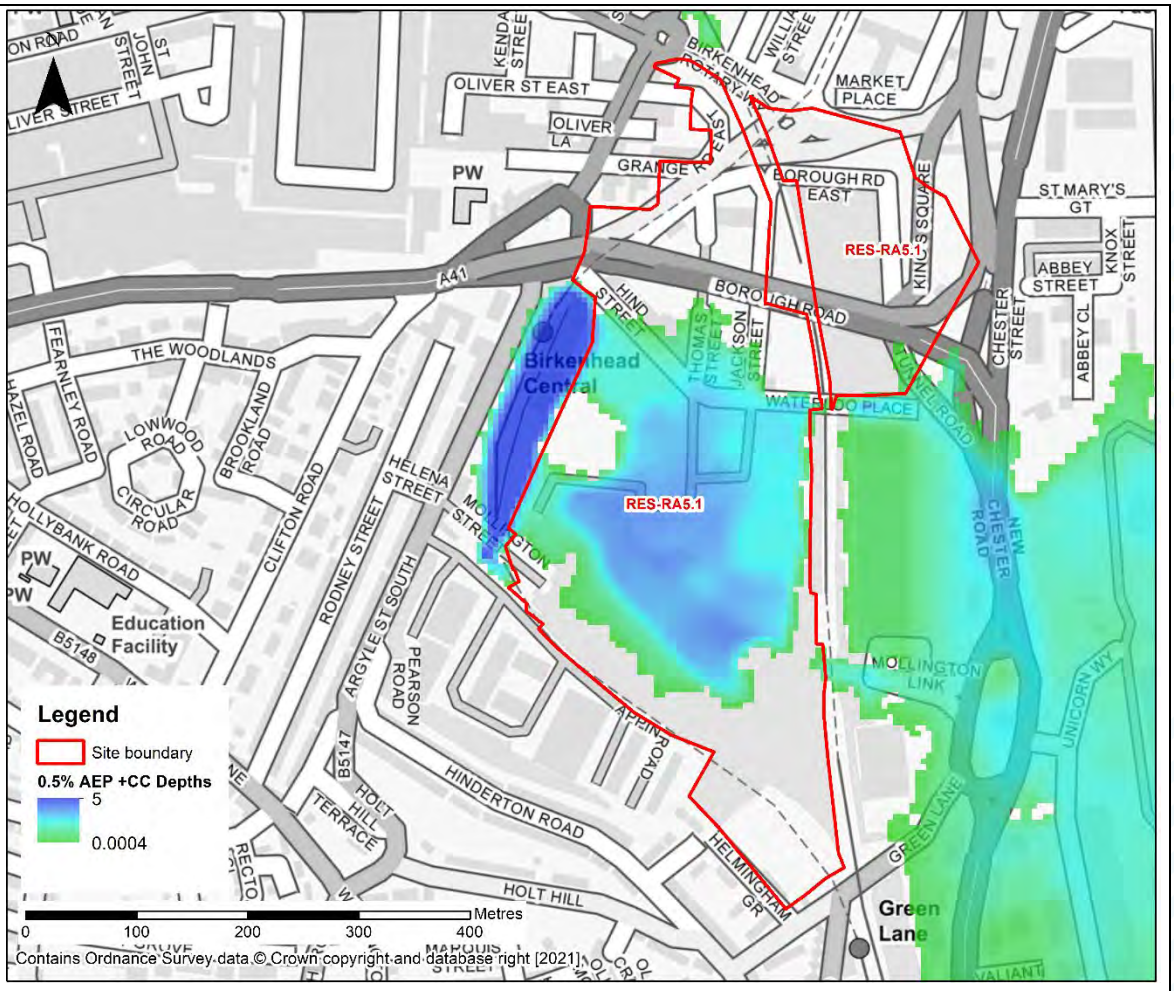
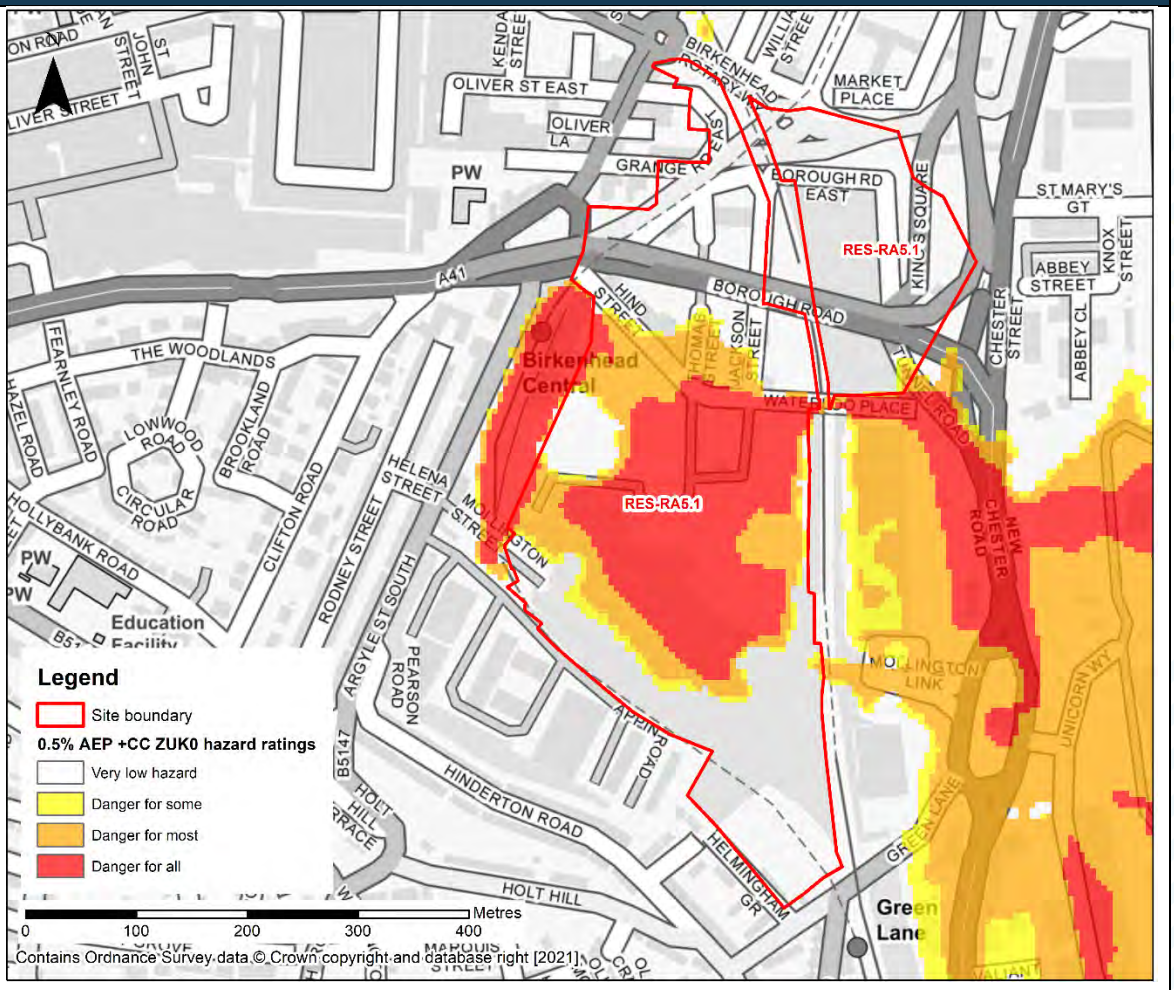


Figure 4: modelled tidal flood depths (m) for 0.5% AEP + climate change event

RES-RA5.1: SHLAA 4078 Hind street	
	 **Figure 5: modelled tidal flood hazard for 0.5% AEP +climate change event** **Tidal hazard ratings based on Table 4 of the SUPPLEMENTARY NOTE ON FLOOD HAZARD RATINGS AND THRESHOLDS FOR DEVELOPMENT PLANNING AND CONTROL PURPOSE – Clarification of the Table 13.1 of FD2320/TR2 and Figure 3.2 of FD2321/TR1. May 2008.* Climate change will significantly impact the site in the long term. Tidal depths within the site boundary reach a maximum of 3 m along the western boundary. Flood hazards across the site are mostly 'danger for all'.
Historic flooding	According to the EA's Historic Flood Map, there are no known historic flooding incidents that have occurred within the vicinity of the site.
Defences	There is no known flood defence infrastructure in the vicinity of the site.
Flood Warning Area	According to the EA's FWA dataset, there are no FWAs in operation within the boundaries of the site.
Natural Flood Management / Working with Natural Process	According to the national scale 'potential for WwNP dataset', there are no opportunities for Natural Flood Management within the vicinity of the site.

RES-RA5.1: SHLAA 4078 Hind street	
Observations, mitigation options & site suitability: tidal	- The proposed use of development would see a change in risk classification from less vulnerable to more vulnerable according to the NPPF. - Given the change in use and therefore vulnerability of the site, 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 change of use meets the objectives of the Framework'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). - The site is entirely within Flood Zone 1 according to the Flood Map for Planning. However, the Mersey Estuary 0.5% AEP event +CC outputs indicate that 41% of the site is at risk of tidal flooding in the future, with depths across the site reaching a maximum level of 3 m. - The majority of the site (59%) is still developable, however due to the location of the climate change flood extents through the central portion of the larger area of the site, development yields would likely be significantly impacted in order to avoid the climate change risk area. - The modelled 0.5% AEP event +CC outputs indicate safe access and egress routes would be achievable to both the north and south of the larger parcel of the site, and would be achievable to the north and east of the smaller parcel. East and west directions are constrained by the railway lines. - Given the modelled risk from climate change, it is recommended this site should not be developed for residential use. Ideally, this site would remain for less vulnerable uses with appropriate resilience measures put in place. - Land raising may be a viable option to raise ground floors above the 0.5% AEP event +climate change maximum level of 3 m however this would likely be a costly solution. The EA would also recommend a further 600mm above the design flood level. Given the risk is tidal, compensatory storage will not be required. - Stilted development may be an option though is likely to be an expensive design solution with access and egress routes also required to be above the design flood level. - A further option may be for ground floor parking or other less vulnerable uses (i.e. non-residential such as shops, restaurants, offices) and for habitable dwellings to be situated on first floor and upwards. However, safe access and egress routes must be available at times of flood, even for above ground floor accommodation.
Flood source: infrastructure failure – reservoirs (residual)	
Flood risk: reservoir	There is no risk of flooding to the site as a result of dam failure, according to the EA's online RFM.
Flood source: infrastructure failure – canals (residual)	
Flood risk: canal	There are no canals in the vicinity of this site.
Flood source: surface water	

Surface Water Flood Risk to Proposed Development Site			
Current site: Risk of Flooding from Surface Water map	High Risk (3.3% AEP event)	Medium Risk (1% AEP event)	Low Risk (0.1% AEP event)
	1.7%	14.3%	36.6%
Surface water max flood depths	0.3 – 0.6 m	0.6 – 0.9 m	> 1.2 m

RES-RA5.1: SHLAA 4078 Hind street

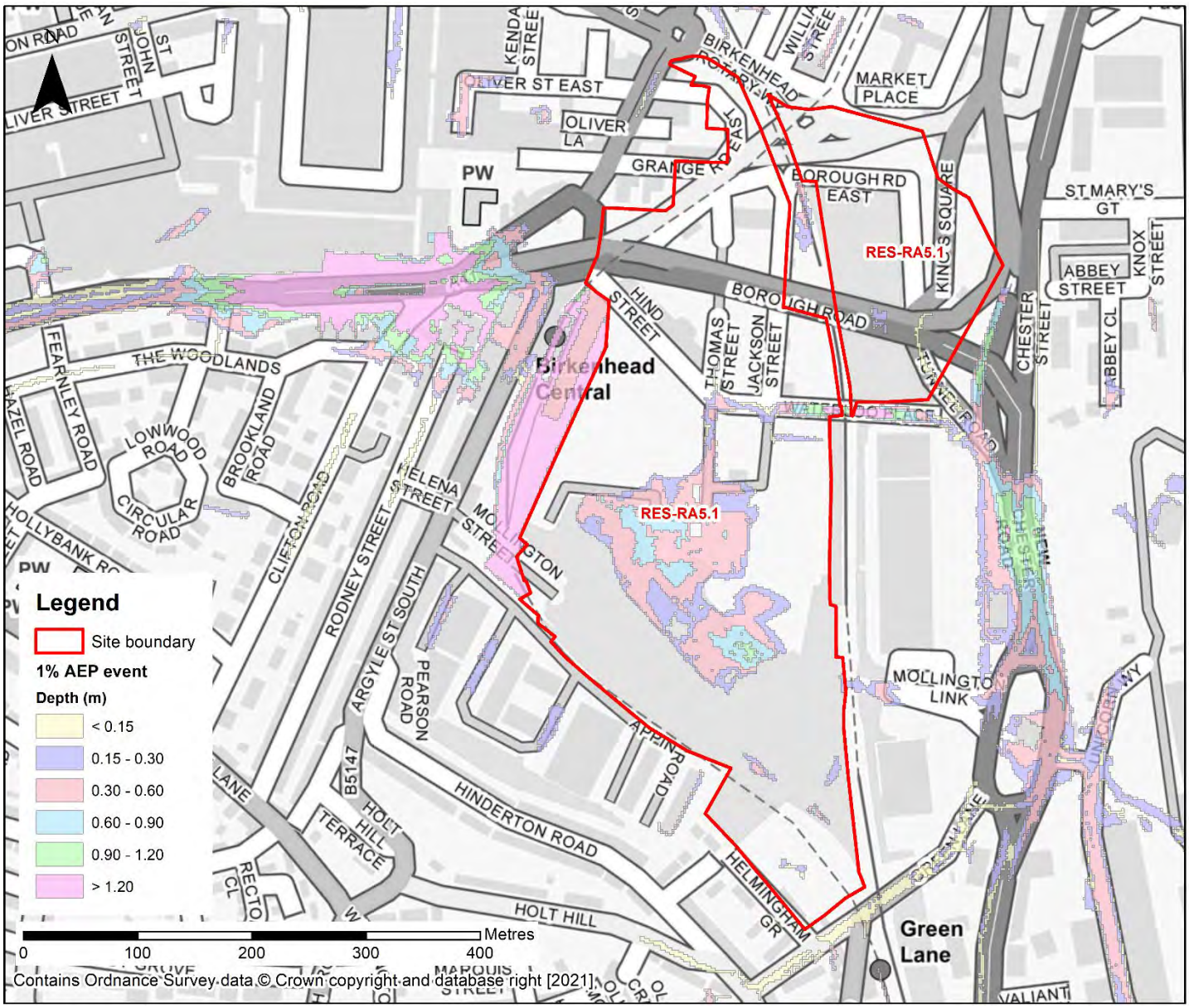


Figure 6: 1% AEP event surface water flood depths (Risk of Flooding from Surface Water map)

RES-RA5.1: SHLAA 4078 Hind street

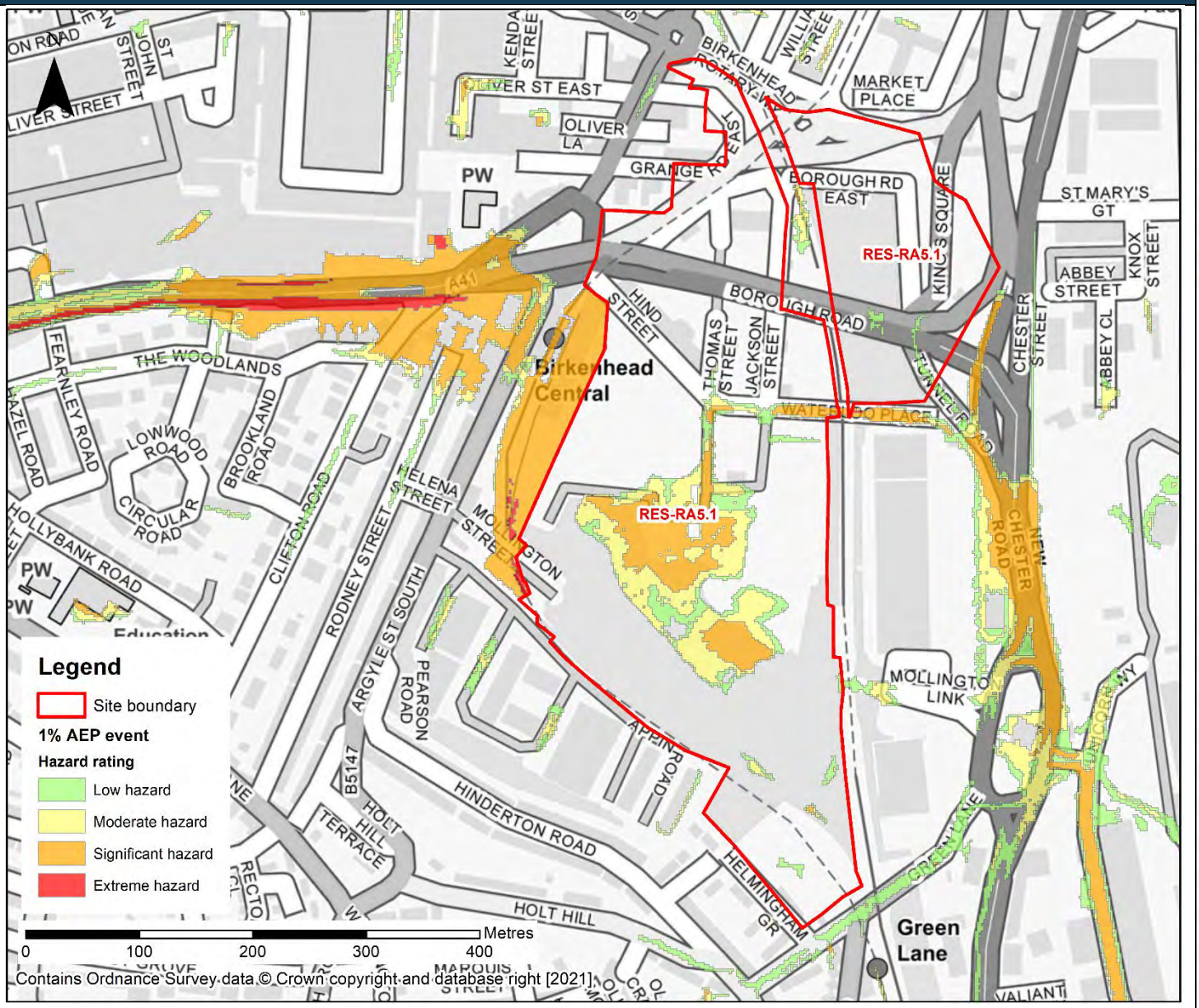


Figure 7: 1% AEP event surface water flood hazards (Risk of Flooding from Surface Water map)

**Surface water hazard rating based on Table 4.2 Hazard to People as a Function of Velocity and Depth, R&D OUTPUTS: FLOOD RISKS TO PEOPLE: PHASE 2 FD2321/TR2. Defra. March 2006.*

Surface water flood risk to development site	Approximately 15% of the site is at risk of surface water flooding in the 1% AEP event to a maximum depth of between 0.6 and 0.9 m and with areas of low, moderate and significant hazard. The risk in all events is primarily localised to the central area of the larger site parcel, with some areas of surface water flood risk scattered around the southern boundary. There are some minimal risk areas within the smaller portion of the site to the north east. The land here is low-lying, hard standing industrial brownfield land.
Climate change	The present day 0.1% AEP event outline provides an indication of the likely increase in extent of the more frequent events. The 0.1% AEP event outline covers around 36% of the total site area and the

extent is primarily across central area of the larger site parcel, but with some additional risk to the east, south and smaller parcel to the north east. Access/egress to the north and south of the site is still possible.

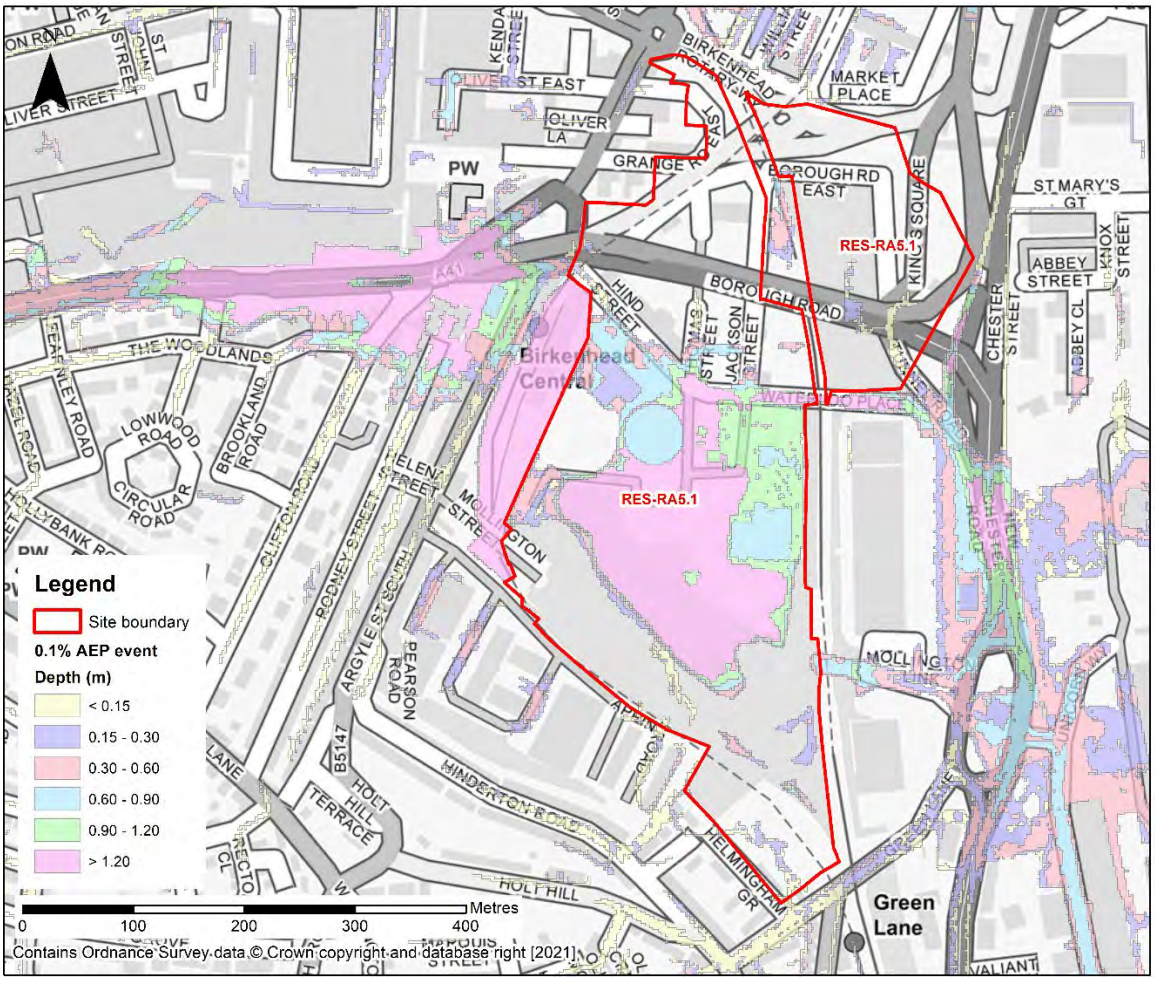


Figure 8: 0.1% AEP event surface water flood depths (Risk of Flooding from Surface Water map)

RES-RA5.1: SHLAA 4078 Hind street

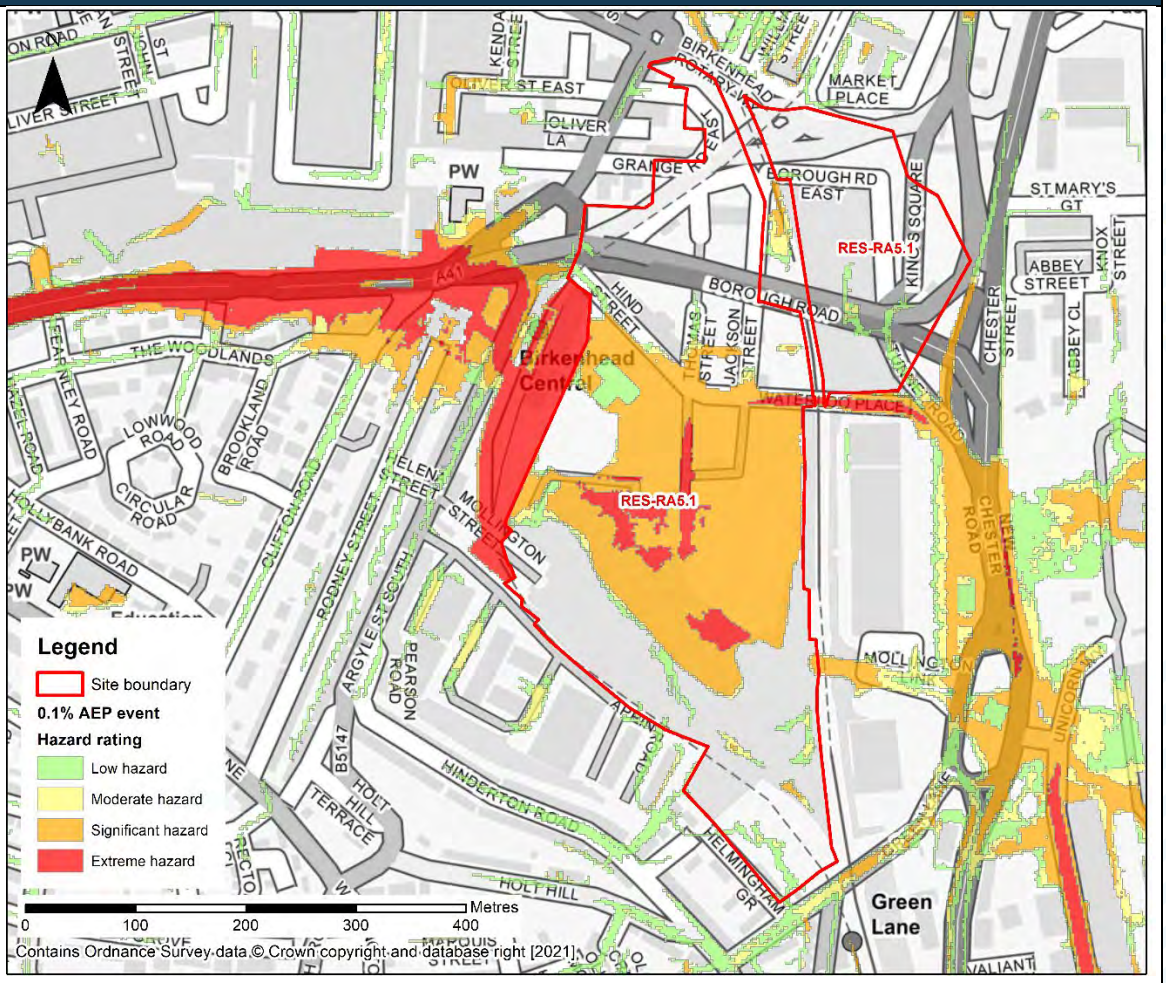
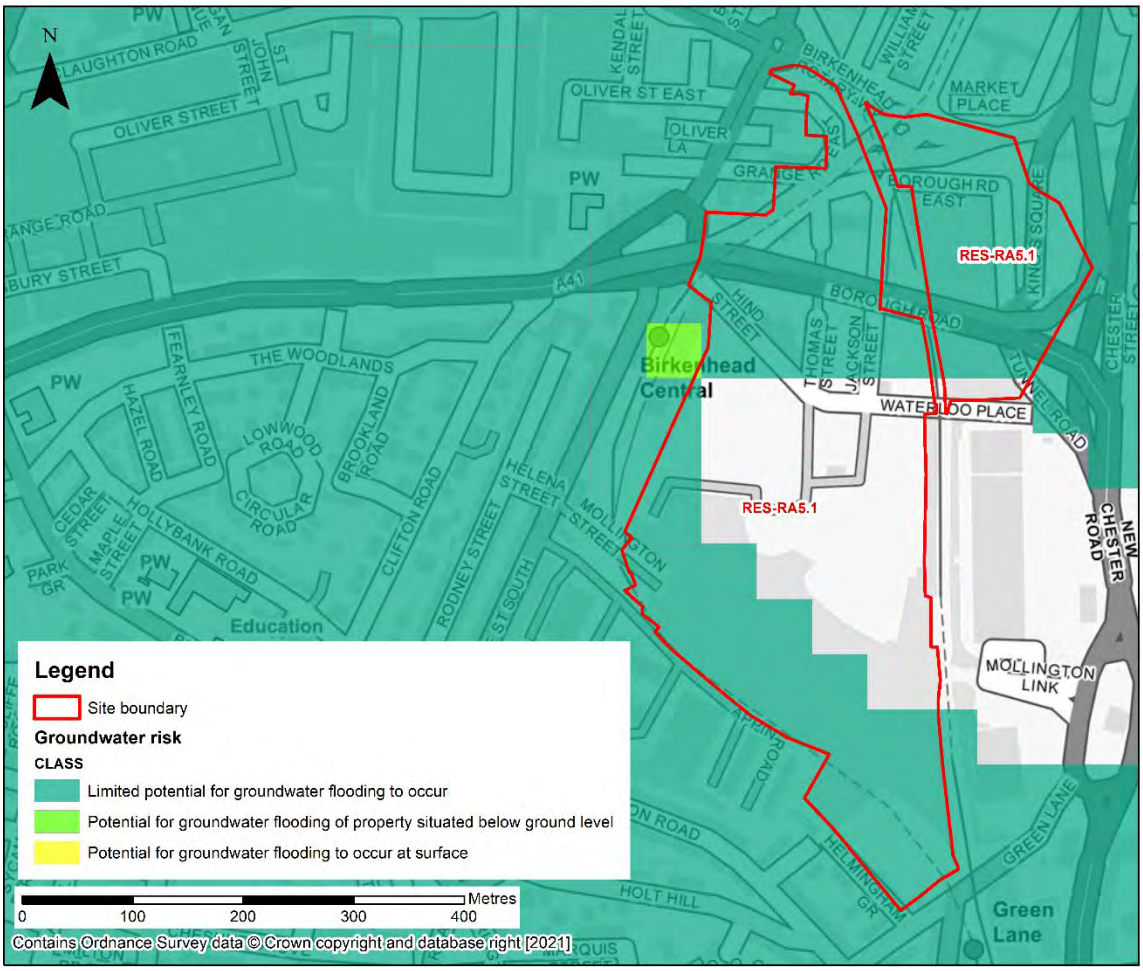


Figure 9: 0.1% AEP event surface water flood hazards (Risk of Flooding from Surface Water map)

Observations, mitigation options & site suitability: surface water

- Judging by the RoFSW map, development of this site may prove challenging. The surface water risk tends to mimic the tidal risk, following the topography.
- The surface water risk shown by the RoFSW map may be dictated and constrained by current land use. Regrading and zoning of the land may be possible to direct flows and storage areas to other parts of the site. All surface water must be mitigated onsite. Infiltration SuDS should be an option judging from the initial groundwater conditions shown on Figure 7.
- However, the RoFSW map is not suitable for making site-specific planning decisions.
- A full drainage strategy would therefore be required to ensure there is no increase in surface water flood risk elsewhere as a result of new development. As part of this, detailed surface water modelling should be carried out post site clearance and pre-development to ascertain natural flow paths. Ideally, development would then not obstruct these flow paths. Site design should ensure flow paths are incorporated into site layout, e.g. through swales and storage ponds.
- Development proposals may be required to provide additional mitigation measures to assist in reducing surface water flood risk elsewhere. SuDS measures to attenuate offsite flows may need to be integrated within the site

RES-RA5.1: SHLAA 4078 Hind street						
	in addition to those managing development runoff. Full consultation with the LLFA will be important at this site. - Assessment of any current drainage system in place should be carried out to ascertain any current capacity issues and whether the current system could accommodate proposed residential development or whether further capacity will be required.					
Surface Water Flood Risk from Proposed Development						
Runoff rates should not exceed current rates and if possible, betterment of existing rates should be aimed for. For the purposes of this assessment, the required volumes of attenuation have been calculated below based on an assumed 85% impermeable area and limiting greenfield runoff rate of Qbar (l/s).						
Proposed development limiting runoff rate: (l/sec) Qbar: 41.57 l/s (FEH Statistical) Q30: 70.66 l/s Q100: 86.46 l/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
30yr Rainfall+20%	8.25	4101	864	3237	30.8	0.216 ha 2.742 %
30yr Rainfall+40%	9.75	4953	1021	3932	37.4	0.262 ha 3.331 %
100yr Rainfall+20%	9.75	5692	1021	4670 (1433 exceedance storage)	44.5	0.311 ha 3.956 %
100yr Rainfall+40%	11	6782	1152	5629 (1697 exceedance storage)	53.6	0.375 ha 4.768 %
Climate change	Application of the central (+20%) and upper end (+40%) allowances for potential change anticipated for the 2080s in the table above shows the estimated attenuation volumes for the 1% AEP and 3.33% AEP rainfall events.					
Surface water: flood risk impacts from development site, mitigation & SuDS	As part of this Level 2 SFRA we have included calculations to provide an estimated land take if a pond with an assumed depth of 1.5m was included as part of the development. Attenuation volumes are presented for the critical storm duration for the 3.33% AEP event with exceedance flows quantified up to the 1% event. To prevent development worsening flood risk elsewhere, surface water runoff must be managed on site.					

RES-RA5.1: SHLAA 4078 Hind street	
Flood Source: Groundwater	
Flood risk: groundwater	 **Figure 10: Susceptibility of groundwater flooding (BGS national dataset)** Based on geological and hydrogeological information, the BGS dataset can be used to identify areas where geological conditions could enable groundwater flooding to occur and where groundwater may come close to the ground surface. The dataset should not be used on its own to make planning decisions at any scale and should not be used to inform planning decisions at the site scale. The susceptibility data cannot be used on its own to indicate risk of groundwater flooding. The dataset shows that there is limited potential for groundwater flooding to occur within the smaller site parcel and along the northern, western and southern boundaries of the larger parcel. Further investigation should be carried out in these areas at the FRA stage.
Overall Site Assessment	
Access and egress	Based on the risk presented, safe access and egress routes should be possible to the larger site parcel from the south of the site via Appin Road, and the north via Birkenhead Rotary Way. Access and egress should be possible to the north and east of the small site parcel via Birkenhead Rotary Way and Chester Street respectively.

RES-RA5.1: SHLAA 4078 Hind street	
Recommendation summary	Based on the evidence presented in the Level 1 SFRA and this Level 2 SFRA: - Early discussions should take place with the EA with regards to the tidal flood risk issues on this site. The EA offers early engagement through an advisory service via their website (https://www.gov.uk/guidance/developers-get-environmental-advice-on-your-planning-proposals) or by emailing the local office: SPPlanning.RFH@environment-agency.gov.uk. - Development should be directed to the areas outside of the climate change risk area. - Based on current ground conditions, there should be no development in the low-lying area within the centre of the site. Expected development yields may have to be revised. - Development should be possible within the smaller site parcel to the north east. - Based on the 0.5% AEP event +climate change, this site should not be developed for residential use. Ideally, this site would remain for less vulnerable uses with appropriate resilience measures put in place. - Early consultation with the LLFA should be carried out regarding surface water flood risk control and mitigation onsite. - Detailed surface water modelling should be carried out post site clearance and pre-development to ascertain natural flow paths and depressions. Regrading of the land and redirecting of surface water should be assessed with layout plans including for SuDS and storage of surface water onsite. - Investigation into appropriate SuDS options should be explored to reduce the risk of surface water flooding from the site.
Can the second part of the Exception Test be satisfied?	Site not subject to the Exception Test though development may be permitted assuming it can be shown that surface water and long term tidal flood risk can be mitigated effectively onsite and included within the site design. If not, development of this site should not be permitted.
FRA requirements	- Further modelling of surface water risk pre and post development options should be carried out with full consultation with the LLFA. - Options for land raising could be assessed and modelled for any development planned in Flood Zone 3a +climate change. - The FRA should include a detailed drainage strategy for the proposed new development layout. - Emergency Plan should accompany the FRA detailing safe access and egress routes in times of flood. - Any FRA should be carried out in line with the NPPF; FRCC-PPG; Local Plan and LLFA policies; and national and local SuDS policy and guidelines. - Throughout the FRA process, consultation should be carried out with the following, where applicable, the LPA; LLFA; emergency planning officers; EA; UU; the highways authorities; and the emergency services.

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Wirral Level 2 Strategic Flood Risk Assessment

Site RES-RA6.1

Final Report

April 2022

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Revision History

Revision Ref / Date	Amendments	Issued to
V1.0 Draft September 2021	-	John Entwistle
V2.0 Draft December 2021	Council and EA comments addressed	John Entwistle
V3.0 Final March 2022	Site boundary merged with RES-RA6.2	John Entwistle

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Analyst

Reviewed by ..... Mike Williamson BSc MSc CGeog FRGS EADA

Principal Flood Risk Analyst

Purpose

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Abbreviations

AOD	Above Ordnance Datum
BGS	British Geological Survey
EA	Environment Agency
FRCC-PPG	Flood Risk and Coastal Change Planning Practice Guidance
FMfP	Flood Map for Planning
FAA	Flood Alert Area
FRA	Flood Risk Assessment
FWA	Flood Warning Area
HFM	Historic Flood Map
LIDAR	Light Detection and Radar
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
NPPF	National Planning Policy Framework
RFM	Reservoir Flood Map
RoFSW	Risk of Flooding from Surface Water
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Drainage Systems
UU	United Utilities
WFD	Water Framework Directive

RES-RA6.1: Wirral Waters – Sky City	
Location	Wirral Waters
Site area (ha)	5.07
Watercourse	The Birket/West Float
EA Model used	Mersey Estuary 2018 Model
Existing use	Commercial
Existing site flood risk vulnerability classification (NPPF)	Less vulnerable
Proposed use	Mixed use
Proposed development flood risk vulnerability classification (NPPF)	More vulnerable
Proposed development impermeable area (ha)	4.31
Note: this site has been merged with the adjacent site RES-RA6.2 since this Level 2 SFRA was produced. The site reference of the merged site is RES-RA6.2.	

RES-RA6.1: Wirral Waters – Sky City

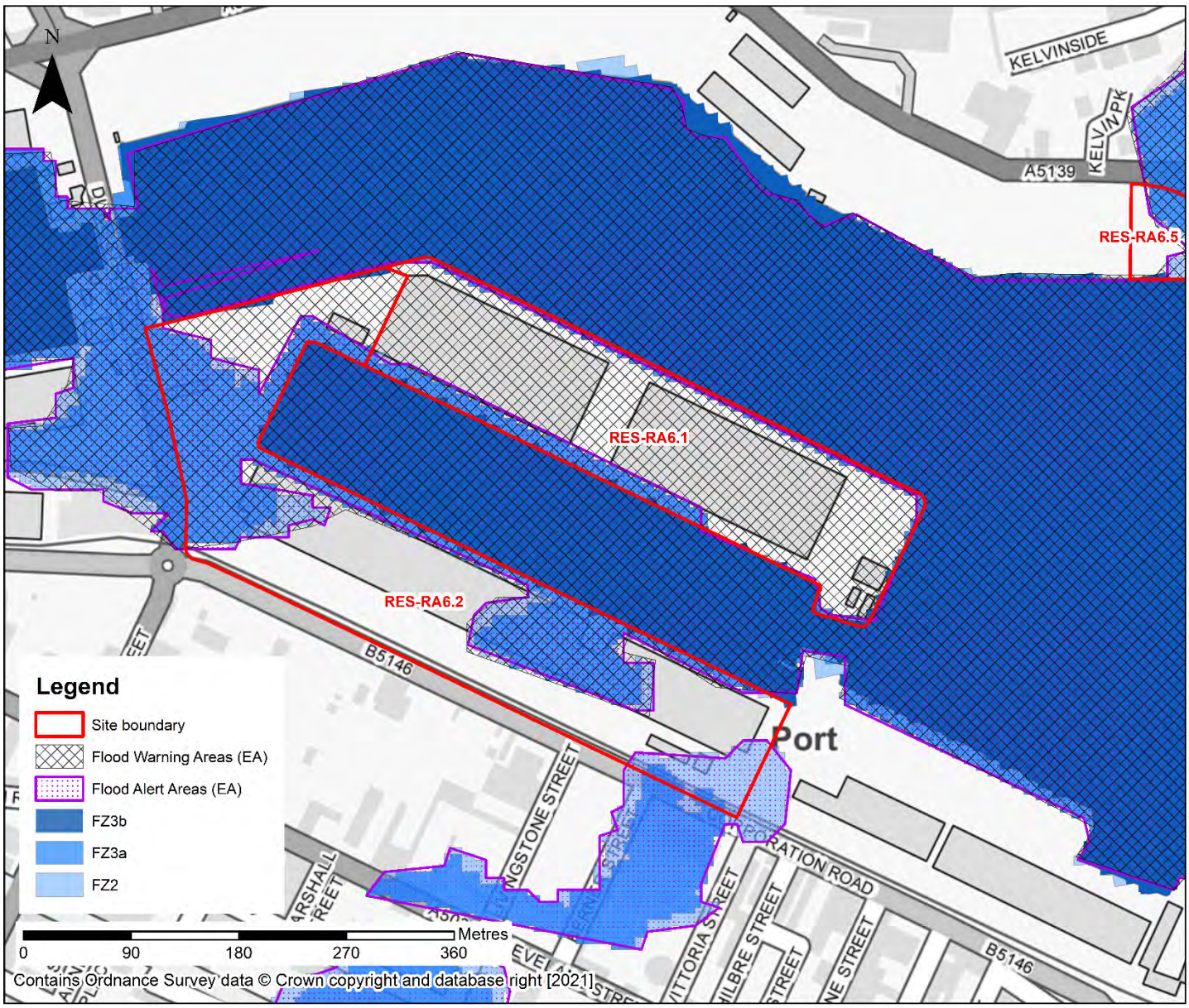


Figure 1: Existing fluvial and tidal flood zones, and flood risk data

The site is a docking strip within the East Float of the port adjacent to the Mersey Estuary and Vittoria Dock. The Birket flows eastwards in the Mersey Estuary to the north of the site. The site is almost completely surrounded by water and sits within Flood Zone 1, with the exception of a narrow strip along the southern boundary, which is within fluvial Flood Zone 3a, according to the Flood Map for Planning. The EA has confirmed that the risk in this area is dominated by tidal risk and fluvial risk is very low. It is likely the Flood Map for Planning will be updated in due course to reflect this. A small portion of the site also lies within Flood Zone 3b (2.5%), however this is confined to the boundaries of the site along the tidal waterbody. The site lies within a FWA and a FAA area is in place along the southern boundary, coinciding with the location of Flood Zone 3a. Safe access and egress routes appear limited. There is no historic flooding mapped within the vicinity of the site.

RES-RA6.1: Wirral Waters – Sky City

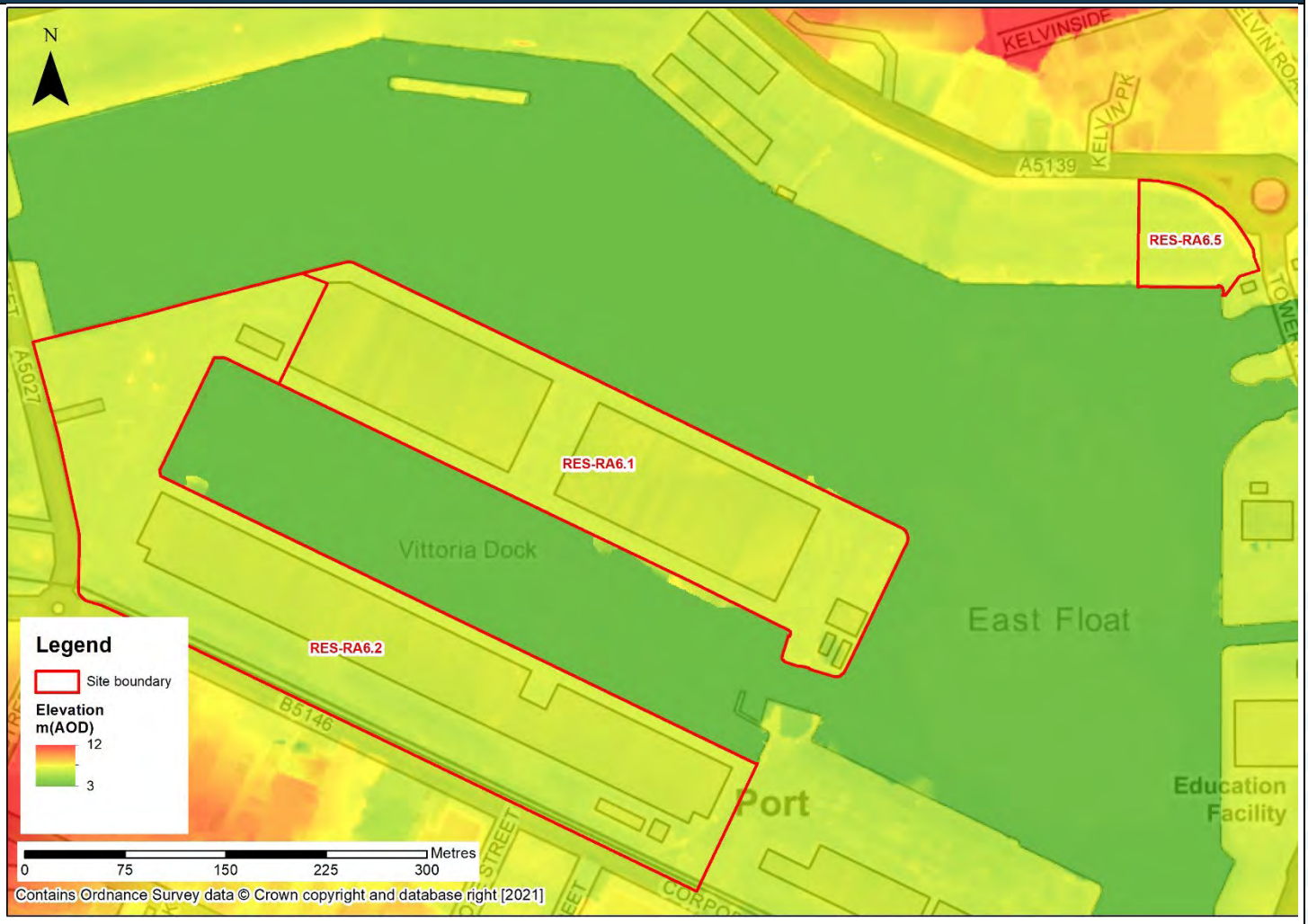


Figure 2: Topography

The site is situated at approximately 7m AOD which does not vary.

Flood Source: Tidal					
Flood Zones	Flood Zone 3b	Flood Zone 3b +climate change*	Flood Zone 3a	Flood Zone 3a +climate change*	Flood Zone 2
	2.5%	+1.4%	12.1%	+87.9	0.2%
Tidal: maximum depth	N/A	0.9 m	0.64 m	1.8 m	N/A
All figures stated based on undefended model *Climate change figures based on 70th percentile (higher central allowance)					

RES-RA6.1: Wirral Waters – Sky City

Modelled tidal risk including climate change (Mersey Estuary 2018 model)

NOTE: modelled outputs for this SFRA are subtly different to original 2018 modelled outputs due to upgraded modelling and GIS software

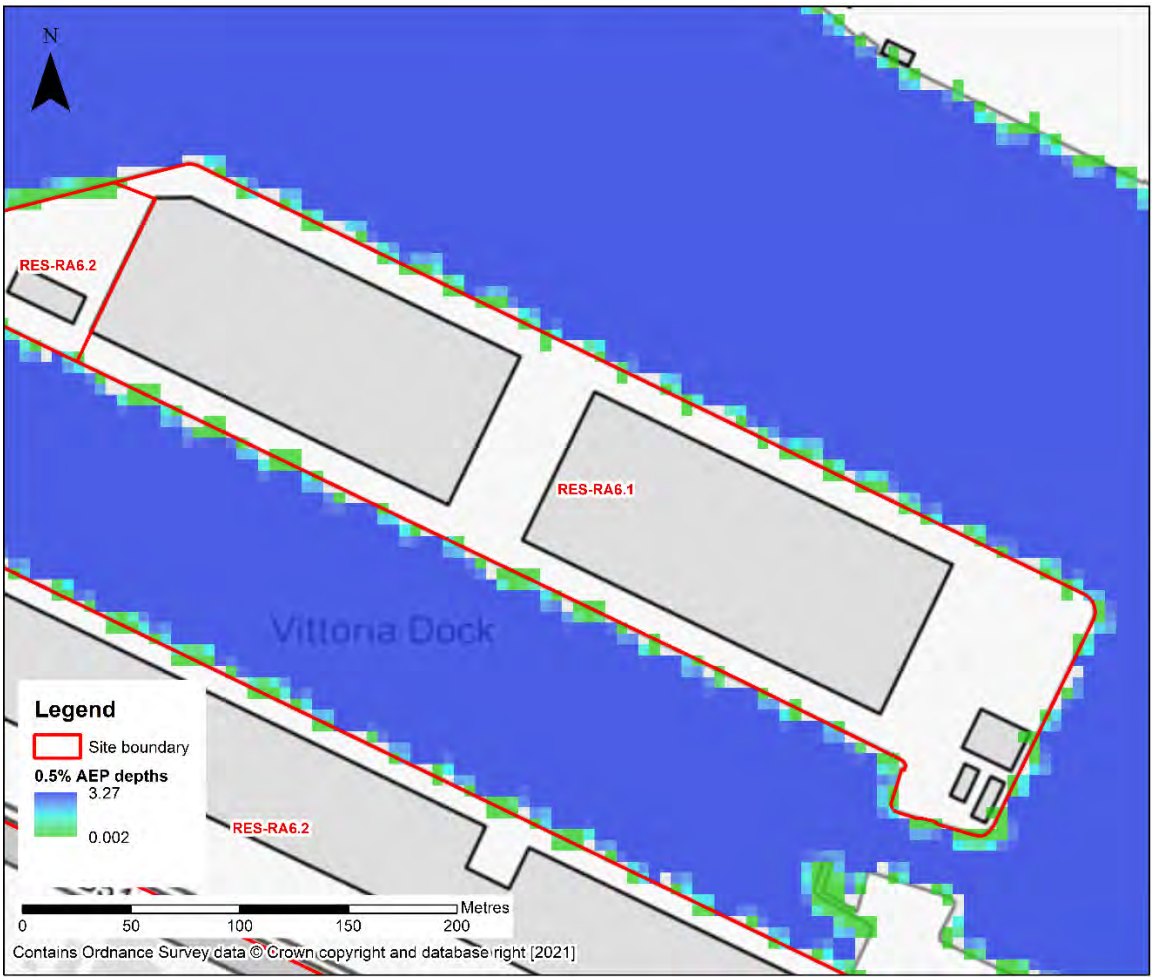


Figure 3: modelled tidal flood depths (m) for 0.5% AEP baseline event

NOTE: the modelling outputs presented at this site are from the Mersey Estuary 2018 coastal model only. Although Flood Zone 3 (Figure 1) on the site is stated as fluvial, the modelled outputs are tidal only, hence the difference in Flood Zone 3a in Figure 1 and the modelled tidal 0.5% AEP event outline shown above in Figure 3. However, the risk to the site in the long term is dominated by tidal flooding. The EA has also confirmed that fluvial risk in this area is very low

Figure 4: modelled tidal flood hazards for 0.5% AEP baseline event

RES-RA6.1: Wirral Waters – Sky City

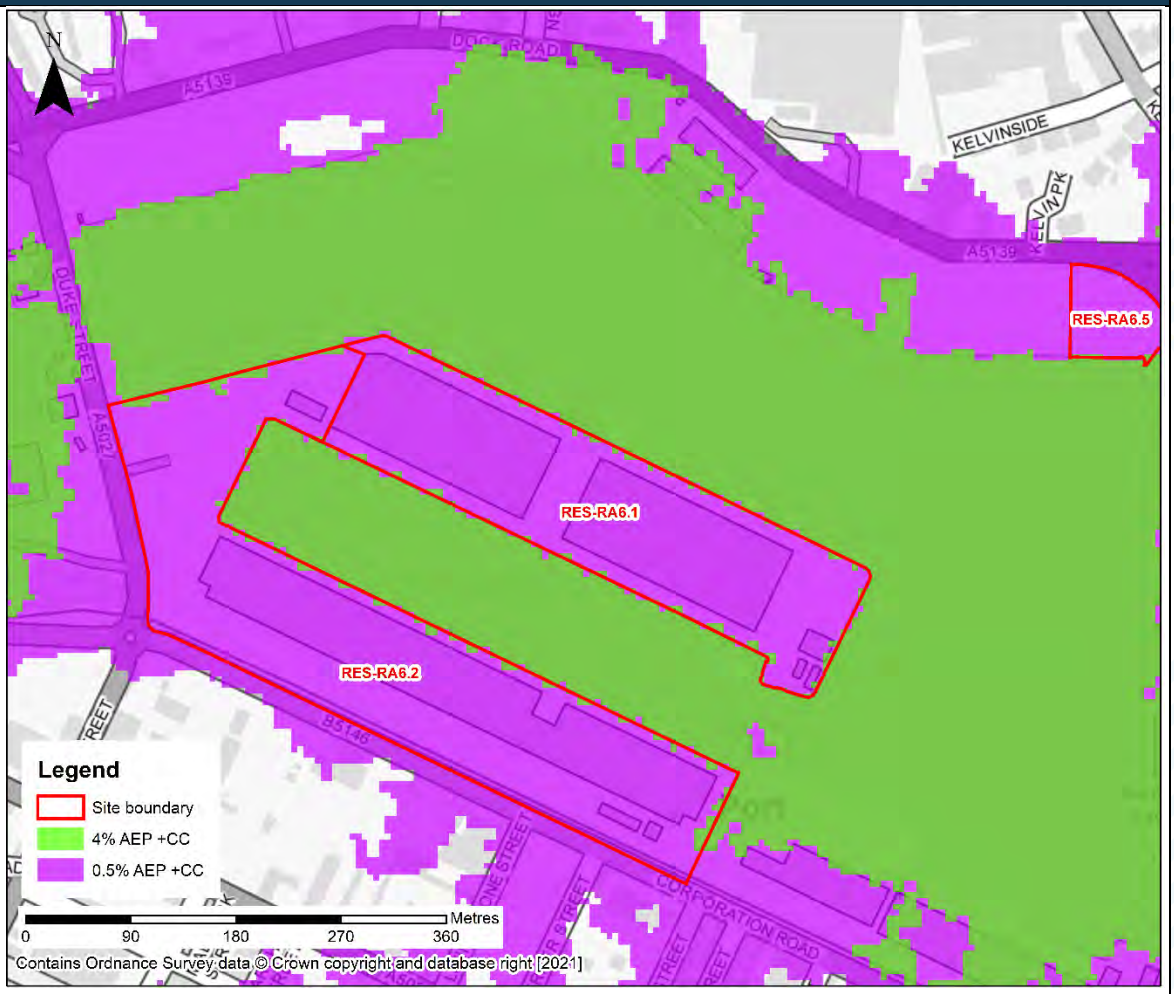


Figure 5: modelled tidal flood outlines for 0.5% AEP plus higher central climate change allowance

RES-RA6.1: Wirral Waters – Sky City

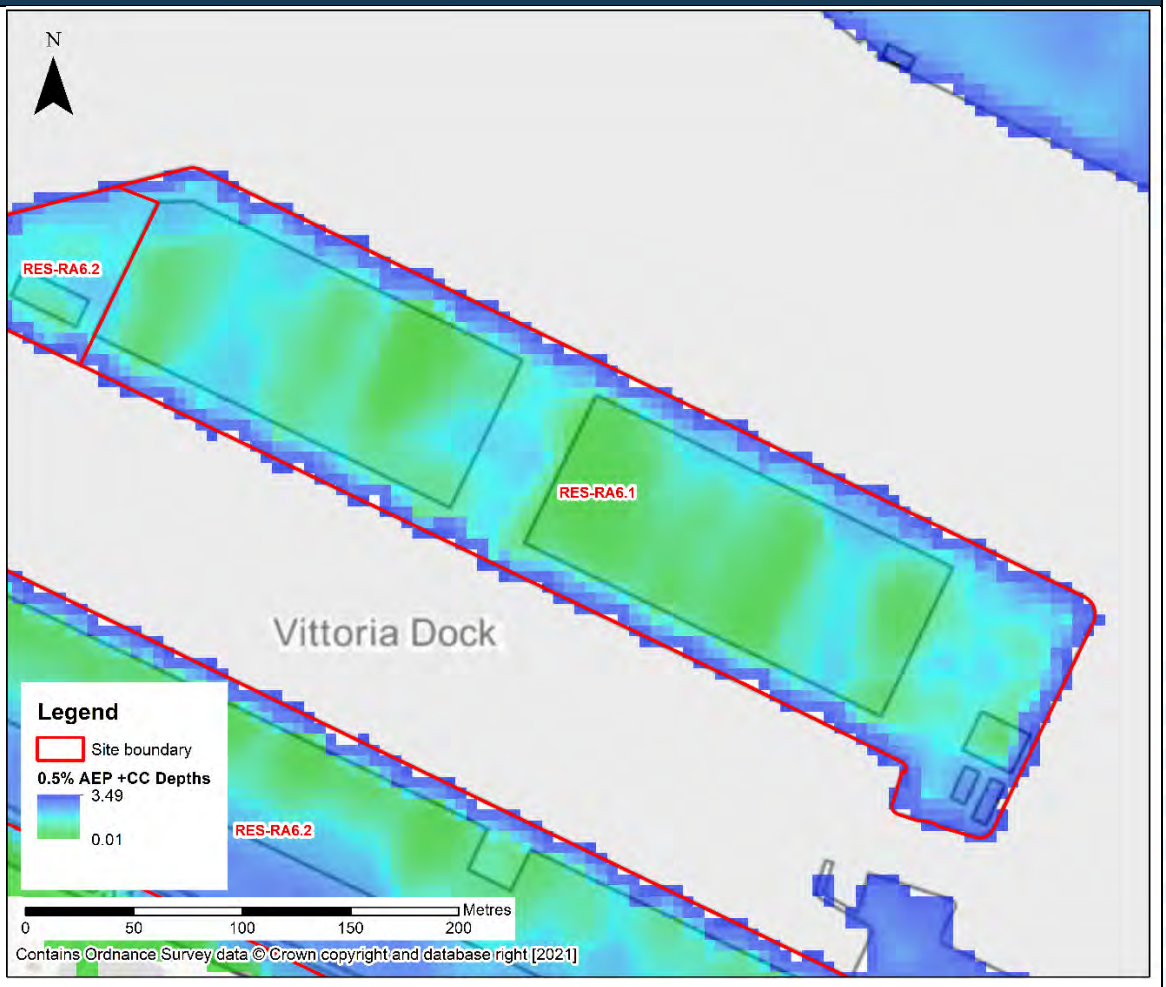
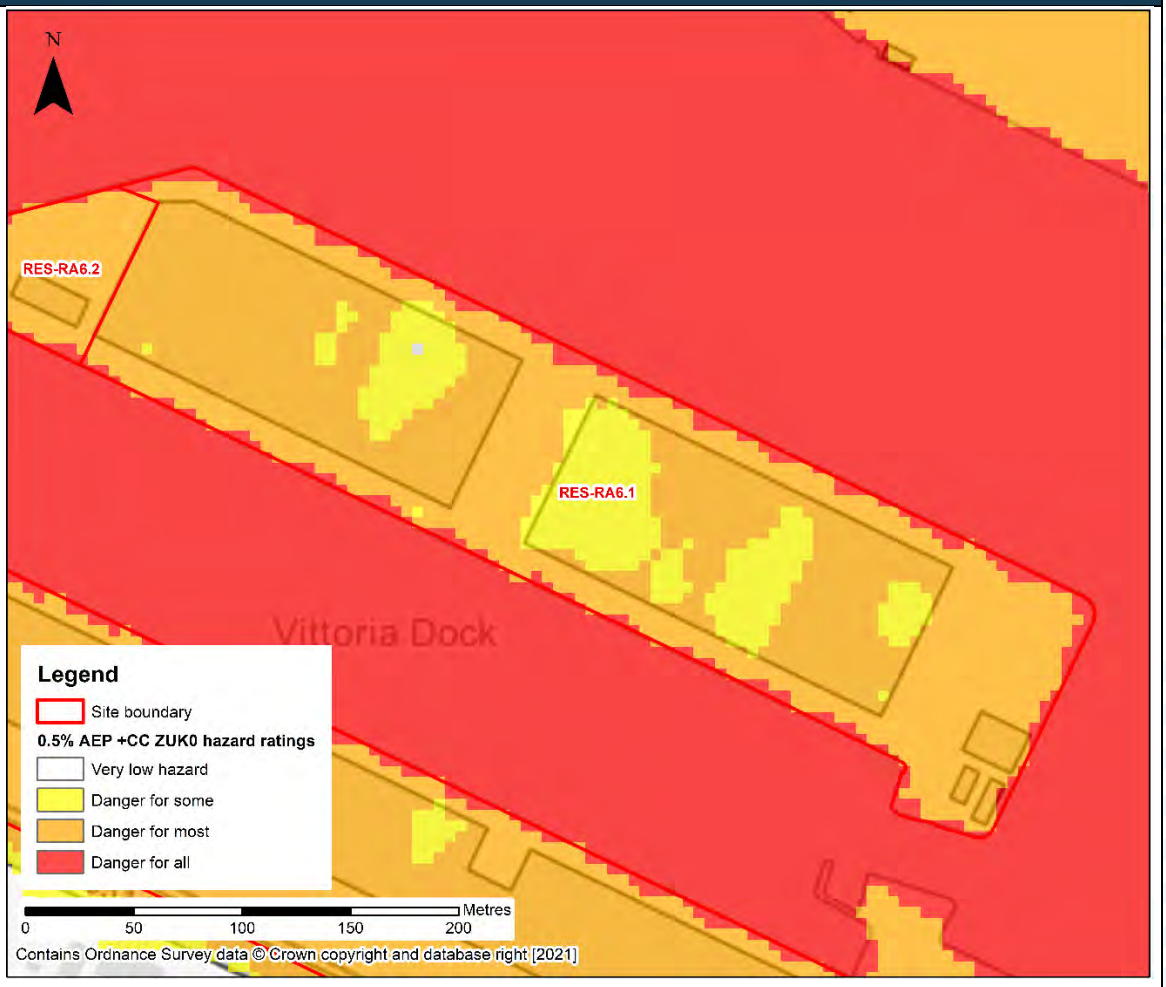


Figure 6: modelled tidal flood depths (m) for 0.5% AEP + climate change event

Note: depth grid erased from open water to provide more accurate representation of flood depths onsite

RES-RA6.1: Wirral Waters – Sky City	
	 **Figure 7: modelled tidal flood hazard for 0.5% AEP +climate change event** **Tidal hazard ratings based on Table 4 of the SUPPLEMENTARY NOTE ON FLOOD HAZARD RATINGS AND THRESHOLDS FOR DEVELOPMENT PLANNING AND CONTROL PURPOSE – Clarification of the Table 13.1 of FD2320/TR2 and Figure 3.2 of FD2321/TR1. May 2008.* It is clear from the above figures that climate change will significantly impact the entire site in the long term. Tidal depths within the site boundary reach a maximum of 1.8 m in the south western corner. Flood hazards across the site are mostly 'danger for most'.
Tidal modelling: modelled land raising	
Modelled tidal risk including climate change on the coast with modelled land raising (Mersey Estuary 2018 model)	Given the significant risk exhibited at this site when accounting for climate change, it was considered necessary to model land raising of the site as a potential mitigation technique to gauge the offsite effects of this. A simple approach was applied whereby the whole site was uplifted to a set value to ensure the whole site was raised out of the flood zone. In reality, the terrain would be gently regraded and reformed to direct displaced water to, most likely, the adjacent docks. Any FRA for the site should assess this further once site layout options are established. It should be noted that modelled outputs represent land raising at both this site and site RES-RA6.2. Therefore, any decisions made to raise the land at this site

should be considered with land raising at the adjacent site RES-RA6.2.

The elevation of the site was uplifted by 3.89 m to reflect the maximum levels for the 0.5% + CC (higher central) event +600 mm freeboard, as recommended by the EA. The updated maximum elevation within the site boundary therefore increased to 11 mAOD. Figure 8 shows the entire site to be flood free when compared to the baseline 0.5% AEP +CC extent in Figure 3.

Site RES-RA6.2 has also been considered and remodelled to assess land raising so there has been no additional impact to this site.

Hazard ratings in the area surrounding the site remain the same.

Figure 8: modelled tidal extents for the 0.5% AEP plus climate change land raising scenario

RES-RA6.1: Wirral Waters – Sky City

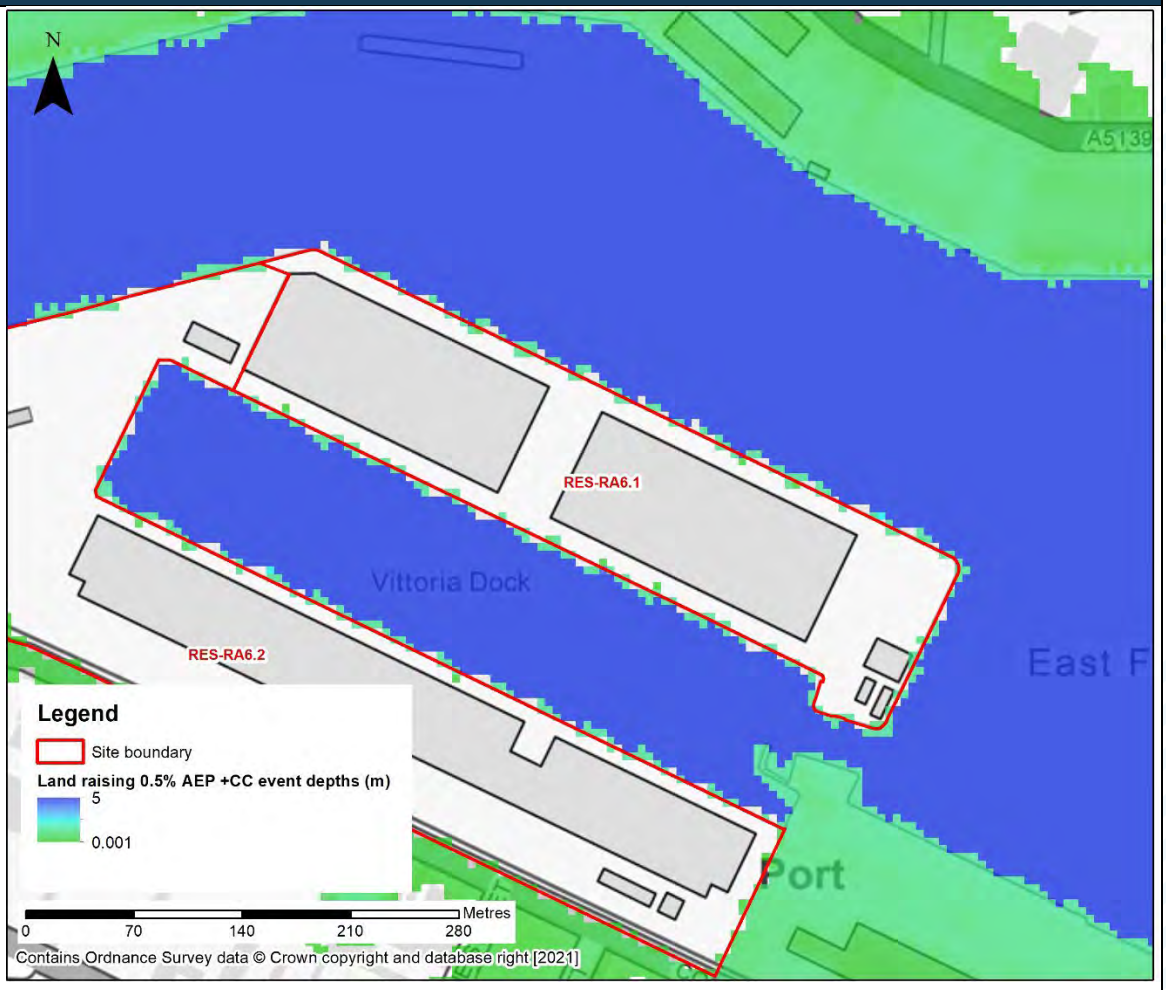


Figure 9: modelled tidal depths for the 0.5% AEP plus climate change land raising scenario

RES-RA6.1: Wirral Waters – Sky City	
	 **Figure 10: modelled tidal hazards for the 0.5% AEP plus climate change land raising scenario**
Historic flooding	There are no areas of historic flooding that affect the site according to the EA's Historic Flood Map (HFM) dataset.
Defences	There is no known flood defence infrastructure in the vicinity of the site.
Flood Warning Area	According to the EA's FWA dataset, there is a FWA for tidal flooding in operation for the west and a section of the east for the Irish Sea and Mersey Estuary from the Head of the Wirral to Runcorn.
Natural Flood Management / Working with Natural Process	According to the national scale 'potential for WwNP dataset', there is no potential for natural flood management across the site.
Observations, mitigation options & site suitability: tidal	- The proposed use of development would see a change in risk classification from less vulnerable to more vulnerable according to the NPPF. - Given the change in use and therefore vulnerability of the site, 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 change of use meets the objectives of the Framework's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through

RES-RA6.1: Wirral Waters – Sky City	
	the lifetime of the development (Para 048 Flood Risk and Coastal Change PPG). - Just over 12% of the site is located within fluvial Flood Zone 3a which covers the southern boundary of the site. However, the EA has confirmed that the risk in this area is dominated by tidal risk and fluvial risk is very low. It is likely the Flood Map for Planning will be updated in due course to reflect this. - The southern site boundary should be pulled back out of Flood Zone 3a or this area should not be developed. - The Mersey Estuary 0.5% AEP event +CC outputs indicate the entire site is at risk of tidal flooding in the future, with depths across the site ranging between 0.3 m to 1.8 m. - Safe access and egress routes must be available at times of flooding. This will prove challenging as the only access road, Duke Street, partly lies within Flood Zone 3a and it entirely at risk from climate change. Any access routes would have to be raised above the 0.5% AEP event +climate change maximum level. Options for raised pedestrian footbridges over the East Float and Vittoria docks to areas outside the 0.5% AEP event +climate change extent should be explored. A FWA is in place however which should provide advanced warning for site users to evacuate ahead of a flood event. - Given the modelled risk from climate change and the difficulties with access and egress routes, it is recommended this site should not be developed for residential use. Ideally, this site would remain for less vulnerable uses with appropriate resilience measures put in place. - The modelled land raising scenario indicates raising the levels of the site to the 0.5% AEP +CC maximum level, plus 600mm freeboard, would protect the site from tidal flooding in the long term. However, raising the site above the required level of 3.89 m would represent a considerable undertaking. - Land raising at site RES-RA6.2 should be implemented with consideration of land raising at this stie. - Although land raising would be a viable option in protecting the site from tidal flooding, access and egress routes would still need to be available during times of flood, therefore raised escape route options should be investigated. - A Flood Risk Activity Permit may be required as the site is within 16 metres of a tidal watercourse. Details on obtaining a Flood Risk Activity Permit are available from the EA. The EA also recommend for an 8m no development buffer alongside any watercourse to allow for maintenance access. - Were development of this site to proceed, given the proximity of this site to the neighbouring RES-RA6.2, it would be prudent to formulate a strategy to develop these sites in tandem and for consultation between each developer to take place to ensure a joined-up approach for sustainable development is in place, with consideration to the strategic solutions outlined in the Level 2 SFRA Summary Report.
Flood source: infrastructure failure – reservoirs (residual)	
Flood risk: reservoir	There is no risk of flooding to the site as a result of dam failure, according to the EA's online RFM.
Flood source: infrastructure failure – canals (residual)	
Flood risk: canal	There are no canals in the vicinity of this site.

RES-RA6.1: Wirral Waters – Sky City						
Flood source: surface water						
Surface Water Flood Risk to Proposed Development Site						
Current site: Risk of Flooding from Surface Water map	High Risk (3.3% AEP event)		Medium Risk (1% AEP event)		Low Risk (0.1% AEP event)	
	0.04%		0.3%		0.3%	
Surface water max flood depths	0.6 – 0.9m		0.3 – 0.6m		0.6 – 0.9m	
Surface water flood risk to development site	Nominal surface water risk to the site.					
Climate change	Nominal risk.					
Observations, mitigation options & site suitability: surface water	- Assessment of the current drainage system in place should be carried out to ascertain any current capacity issues and whether the current system could accommodate proposed residential development or whether further capacity will be required. - A drainage strategy would be required to ensure there is no increase in surface water flood risk elsewhere as a result of new development. This will require consultation with the LLFA.					
Surface Water Flood Risk from Proposed Development						
Runoff rates should not exceed current rates and if possible, betterment of existing rates should be aimed for. For the purposes of this assessment, the required volumes of attenuation have been calculated below based on an assumed 85% impermeable area and limiting greenfield runoff rate of Qbar (l/s).						
Proposed development limiting runoff rate: (l/sec) Qbar: 29.68 l/s (FEH Statistical) Q30: 50.45 l/s Q100: 61.73 l/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
30yr Rainfall+20%	7.25	2565	542	2023	27	0.135 ha 2.660 %
30yr Rainfall+40%	8.75	3114	654	2459	32.8	0.164 ha 3.233 %
100yr Rainfall+20%	8.5	3562	636	2926 (903 exceedance storage)	39	0.195 ha 3.847 %
100yr Rainfall+40%	10.25	4295	767	3529 (1070 exceedance storage)	47	0.235 ha 4.640 %
Climate change	Application of the central (+20%) and upper end (+40%) allowances for potential change anticipated for the 2080s in the table above shows the estimated					

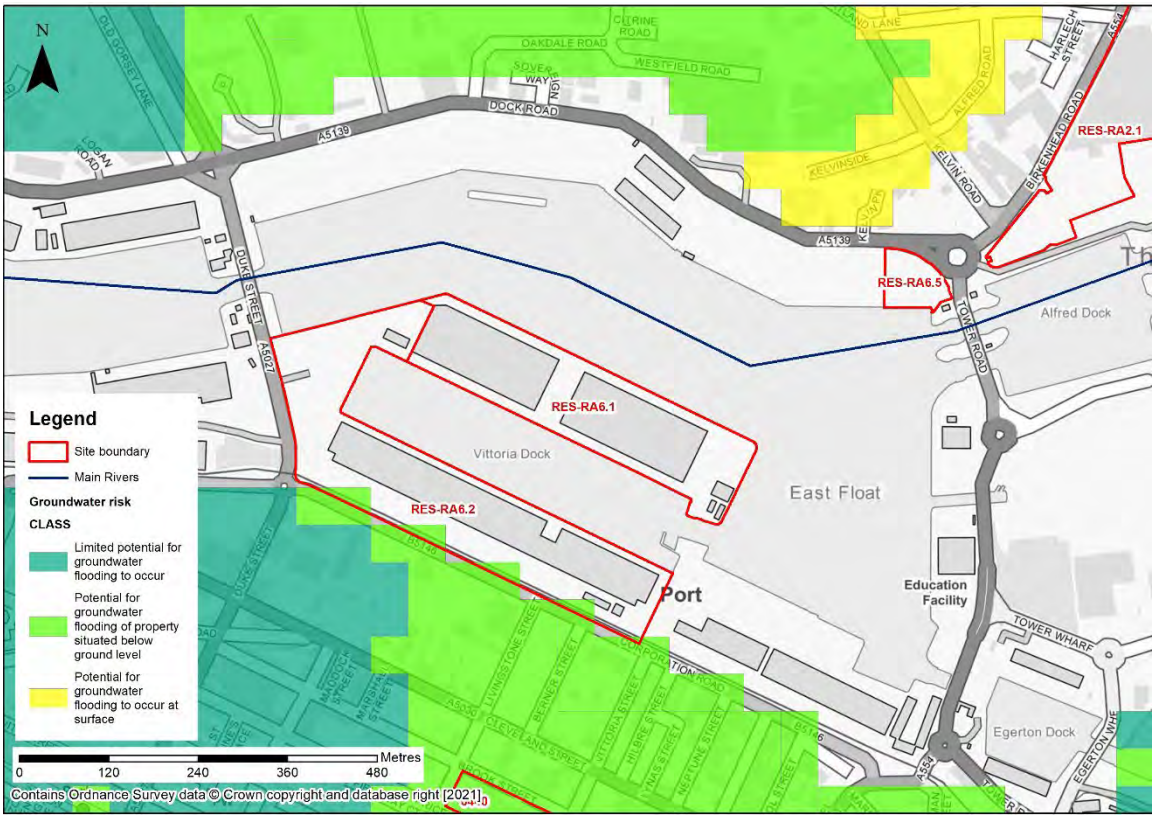
RES-RA6.1: Wirral Waters – Sky City	
	attenuation volumes for the 1% AEP and 3.33% AEP rainfall events.
Surface water: flood risk impacts from development site, mitigation & SuDS	- As part of this Level 2 SFRA we have included calculations to provide an estimated land take if a pond with an assumed depth of 1.5m was included as part of the development. - Attenuation volumes are presented for the critical storm duration for the 3.33% AEP event with exceedance flows quantified up to the 1% event. To prevent development worsening flood risk elsewhere, surface water runoff must be managed on site. - Surface water runoff should be fully attenuated to a pre-agreed runoff rate. SuDS may be possible however, this would be subject to ground investigation and contaminated land assessment at the FRA stage. To prevent development worsening flood risk elsewhere, surface water runoff must be managed on site.
Flood Source: Groundwater	
Flood risk: groundwater	
Overall Site Assessment	

Figure 11: Susceptibility of groundwater flooding (BGS national dataset)

Based on geological and hydrogeological information, the BGS dataset can be used to identify areas where geological conditions could enable groundwater flooding to occur and where groundwater may come close to the ground surface. The dataset should not be used on its own to make planning decisions at any scale and should not be used to inform planning decisions at the site scale. The susceptibility data cannot be used on its own to indicate risk of groundwater flooding.

The dataset shows that the site is not prone to groundwater flooding.

RES-RA6.1: Wirral Waters – Sky City	
Access and egress	Safe access and egress routes may prove challenging as the only access road, Duke Street, lies within Flood Zone 3a. However, the location of the site within a Flood Warning Area should ensure users are evacuated safely in advance of a flood event. Raised walkways may be required and footbridges over the docks should be investigated.
Recommendation summary	Based on the evidence presented in the Level 1 SFRA and this Level 2 SFRA: - Early discussions should take place with the EA with regards to tidal flood risk issues on this site. The EA offers early engagement through an advisory service via their website (https://www.gov.uk/guidance/developers-get-environmental-advice-on-your-planning-proposals) or by emailing the local office: SPPlanning.RFH@environment-agency.gov.uk. - It is recommended that this site should not be developed for residential use given the significant long-term risk with climate change. The site should remain for less vulnerable uses with resilience measures in place. - Modelled land raising scenarios indicate that this could be an option to protect the site from long term tidal flooding. This should be explored at the FRA stage. - No development within 8 m of The Birket/West Float.
Can the second part of the Exception Test be satisfied?	To pass the Exception Test, it must be proven that the site can be safe for its lifetime, which for residential development is 100 years. The climate change modelling in this Level 2 SFRA shows this will not be possible. However, land raising may be a viable option and should be explored further at the FRA stage.
FRA requirements	- The FRA should assess the options for raised pedestrian routes to ensure safe access and egress to the site. - Full consideration should be given to the impact development may have on the adjacent site RES-RA6.2. - The FRA should include emergency planning procedures with consideration to ensuring safe access and egress routes in times of flood. - Any FRA should be carried out in line with the NPPF; FRCC-PPG; Local Plan and LLFA policies; and national and local SuDS policy and guidelines. - Throughout the FRA process, consultation should be carried out with the following, where applicable, the LPA; LLFA; emergency planning officers; EA; UU; the highways authorities; and the emergency services.
LPA decision on allocation / development	

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Wirral Level 2 Strategic Flood Risk Assessment

Site RES-RA6.2

Final Report

April 2022

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WIRRAL

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Revision History

Revision Ref / Date	Amendments	Issued to
V1.0 Draft September 2021	-	John Entwistle
V2.0 Draft December 2021	Council and EA comments addressed	John Entwistle
V2.0 Final February 2022		John Entwistle
V3.0 Final March 2022	Site boundary merged with RES-RA6.2	John Entwistle

Prepared by ..... Hannah Bishop BSc MSc

Assistant Analyst

Reviewed by ..... Mike Williamson BSc MSc CGeog FRGS EADA

Principal Flood Risk Analyst

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FAA	Flood Alert Area
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FWA	Flood Warning Area
HFM	Historic Flood Map
LIDAR	Light Detection and Radar
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
NPPF	National Planning Policy Framework
RFM	Reservoir Flood Map
RoFSW	Risk of Flooding from Surface Water
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Drainage Systems
UU	United Utilities
WFD	Water Framework Directive

RES-RA6.2: Wirral Waters – Vittoria Studios	
Location	Vittoria Dock, Birkenhead
Site area (ha)	7.27
Watercourse	The Birket/West Float
EA Model used	Mersey Estuary 2018
Existing use	Commercial
Existing site flood risk vulnerability classification (NPPF)	Less vulnerable
Proposed use	Mixed use
Proposed development flood risk vulnerability classification (NPPF)	More vulnerable
Proposed development impermeable area (ha)	6.18
Note: this site has been merged with the adjacent site RES-RA6.1 since this Level 2 SFRA was produced. The site reference of the merged site is RES-RA6.2.	

RES-RA6.2: Wirral Waters – Vittoria Studios

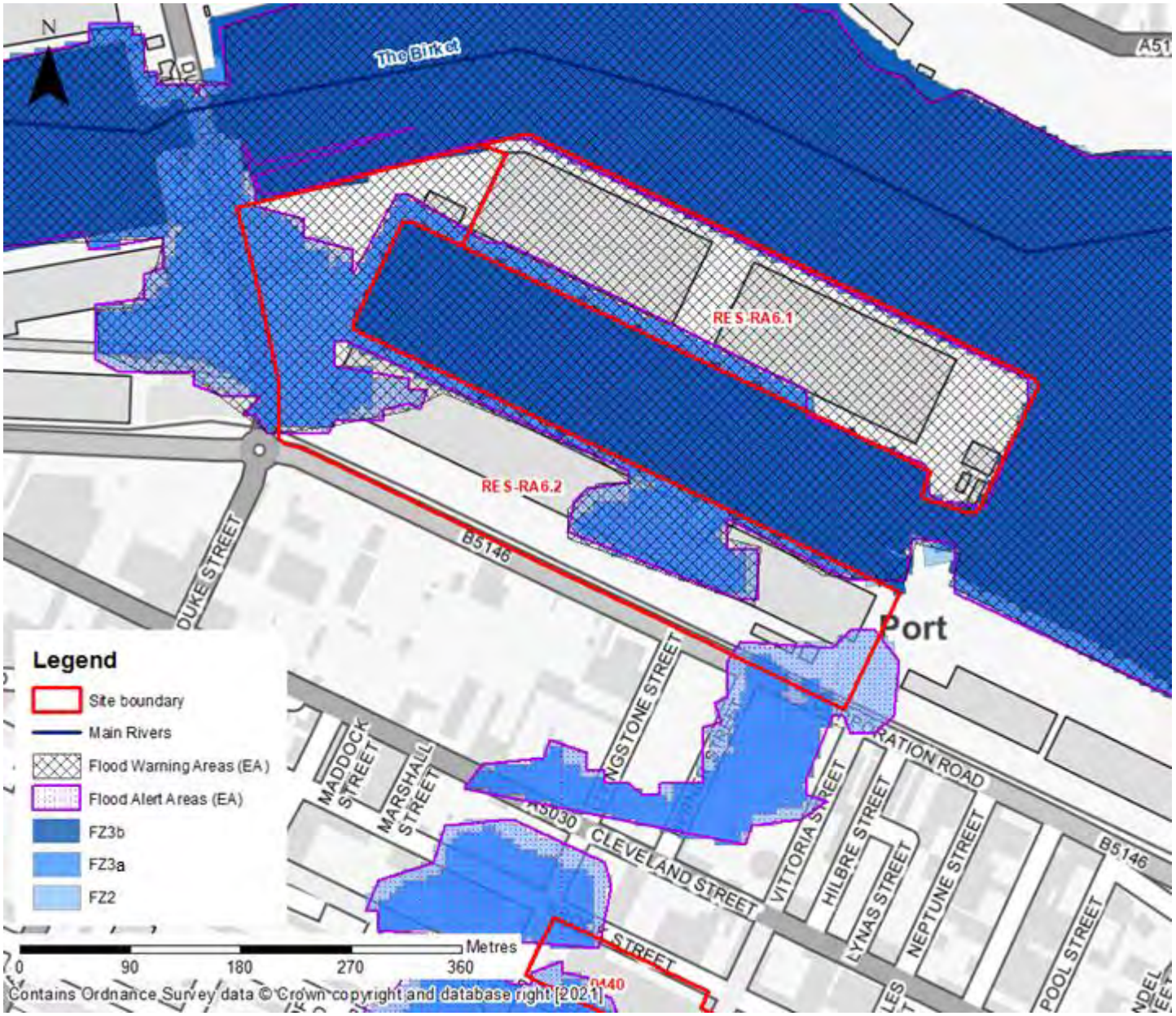


Figure 1: Existing fluvial and tidal flood zones, and flood risk data

The Main River The Birket flows eastwards into the Mersey Estuary to the north of the site with the site being located on Vittoria Dock. 33% of the site is within fluvial Flood Zone 3a, according to the Flood Map for Planning. The EA has confirmed that the risk in this area is dominated by tidal risk and fluvial risk is very low. It is likely the Flood Map for Planning will be updated in due course to reflect this. There is a FWA and a FAA covering the west section and a portion of the east of the site.

RES-RA6.2: Wirral Waters – Vittoria Studios

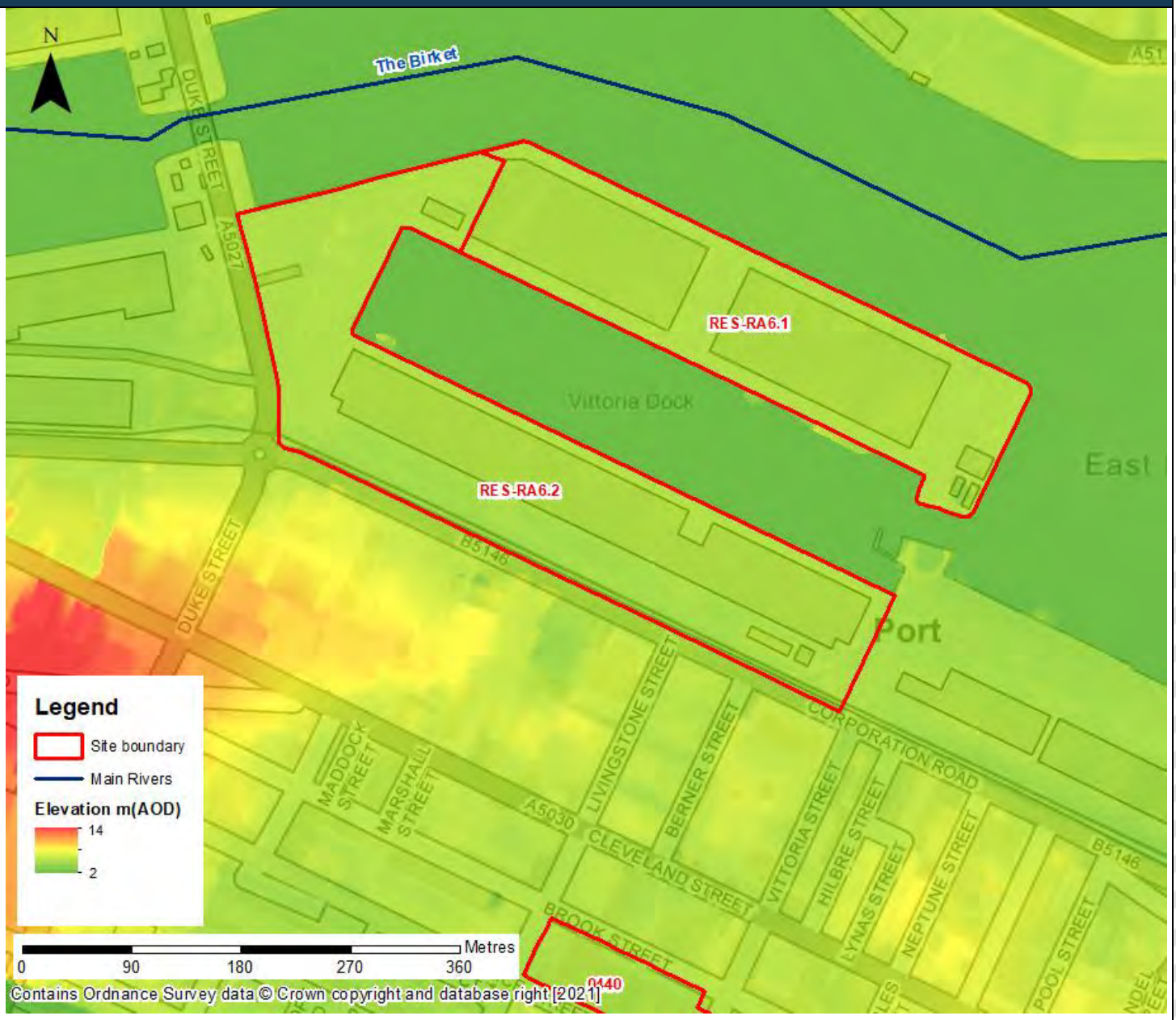
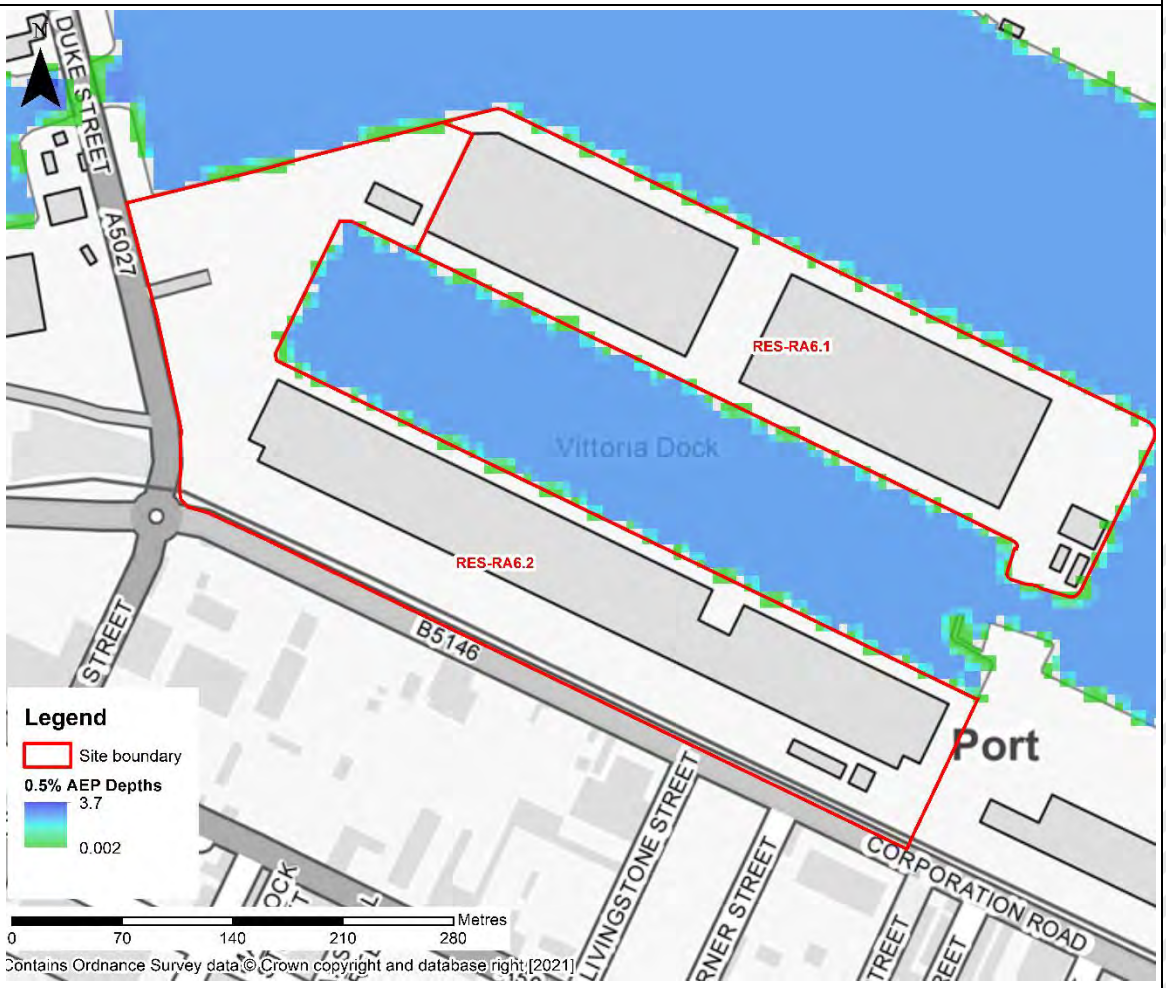


Figure 2: Topography

The elevation across the whole site does not vary substantially ranging between 6.5 and 7 mAOD. The area of water at Vittoria Dock has a lower elevation of approximately 5 mAOD and there is an area of higher elevation to the south west of the site of around 12 mAOD which gradually declines towards the site.

Flood Source: Tidal

Flood Zones	Flood Zone 3b	Flood Zone 3b +climate change*	Flood Zone 3a	Flood Zone 3a +climate change*	Flood Zone 2
	1.6%	+2.0%	33.4%	+66.6%	9.1%
Tidal: maximum depth	Not available	0.1 m	N/A (within waterbody)	0.9 m	Not available

RES-RA6.2: Wirral Waters – Vittoria Studios	
Flood Zone 3b figures stated based on defended model; Flood Zone 3a and 2 figures stated based on undefended model *Climate change figures based on 70th percentile (higher central allowance)	
Modelled tidal risk including climate change (Mersey Estuary 2018 model) NOTE: modelled outputs for this SFRA are subtly different to original 2018 modelled outputs due to upgraded modelling and GIS software	 **Figure 3: modelled tidal flood depths for 0.5% AEP baseline event**

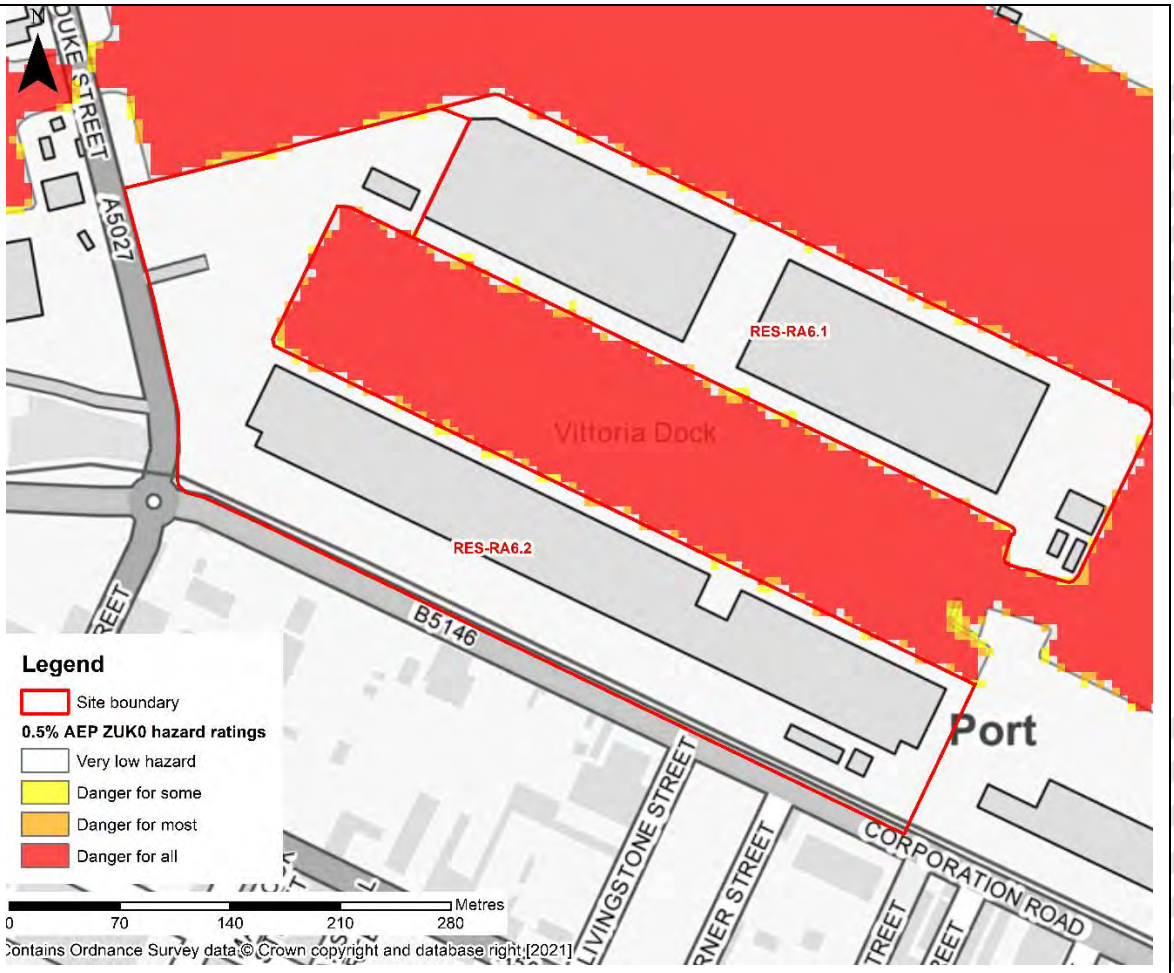


Figure 4: modelled tidal flood hazard for 0.5% AEP baseline event

RES-RA6.2: Wirral Waters – Vittoria Studios

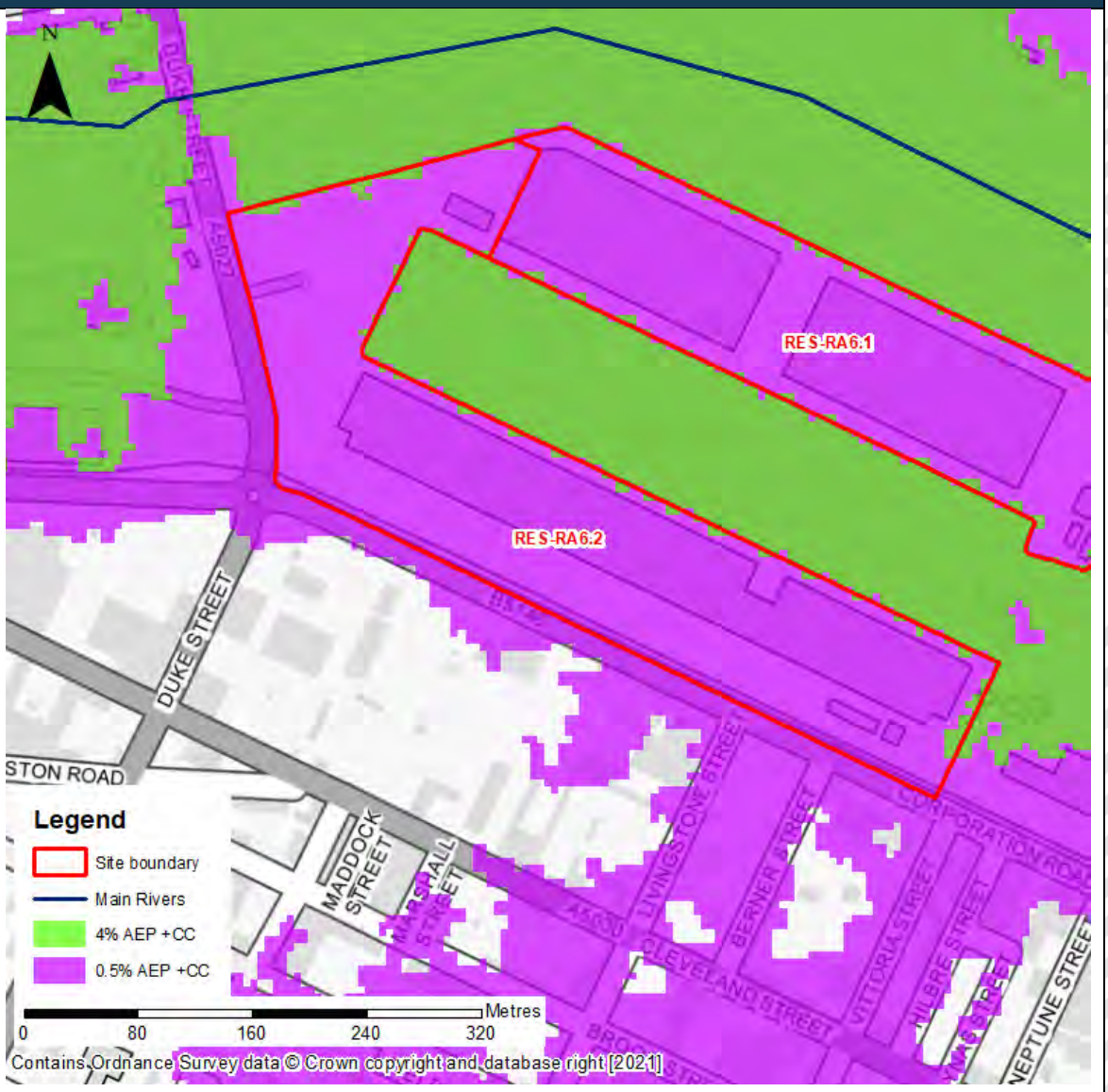


Figure 5: modelled tidal flood outlines for higher central climate change allowance

NOTE: the modelling outputs presented at this site are from the Mersey Estuary 2018 coastal model only. Although Flood Zone 3 (Figure 1) on the site is stated as fluvial, the modelled outputs are tidal only, hence the difference in Flood Zone 3a in Figure 1 and the modelled tidal 0.5% AEP event outline shown above in Figure 3. However, the risk to the site in the long term is dominated by tidal flooding. The EA has also confirmed that fluvial risk in this area is very low.

RES-RA6.2: Wirral Waters – Vittoria Studios

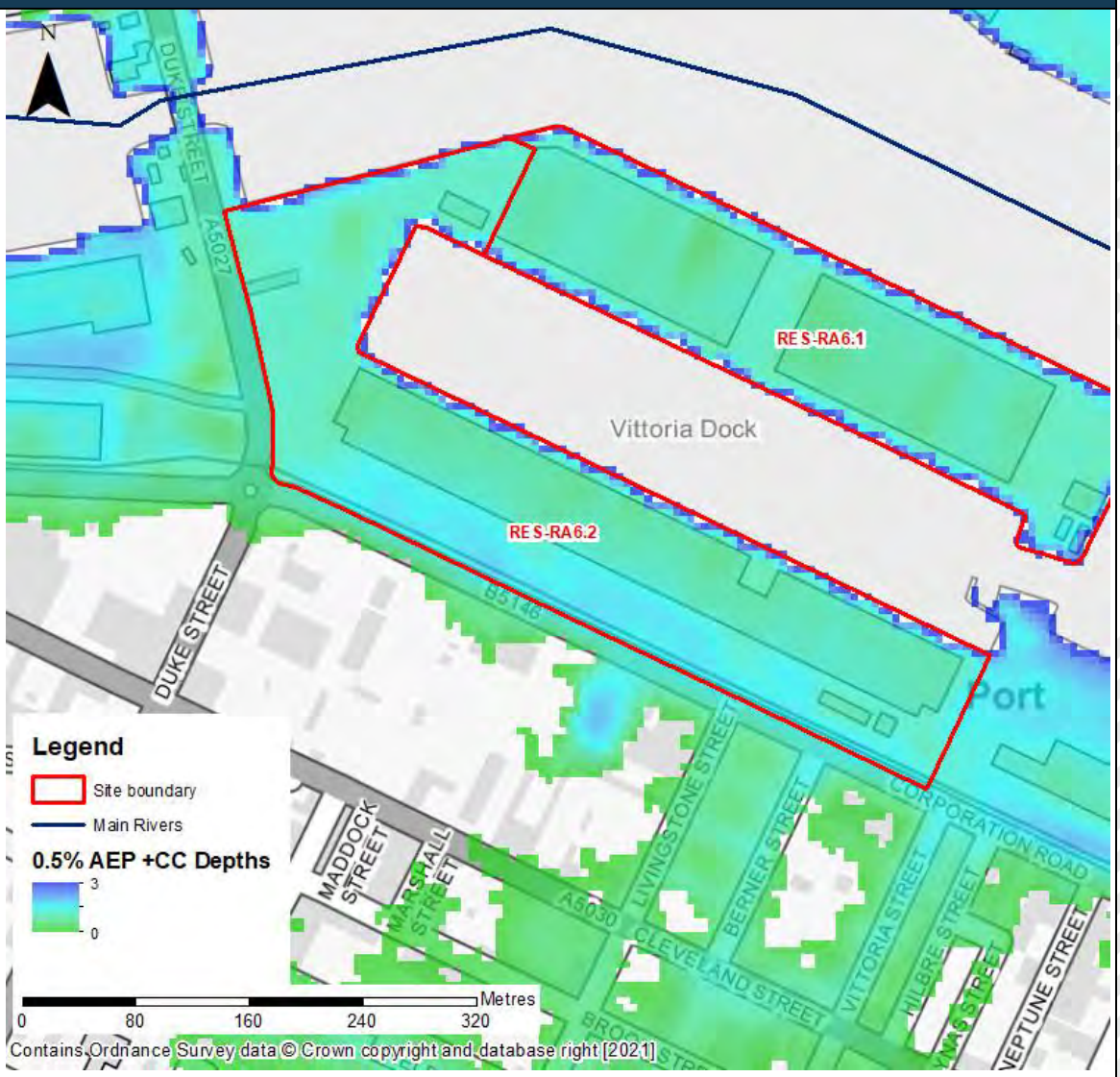
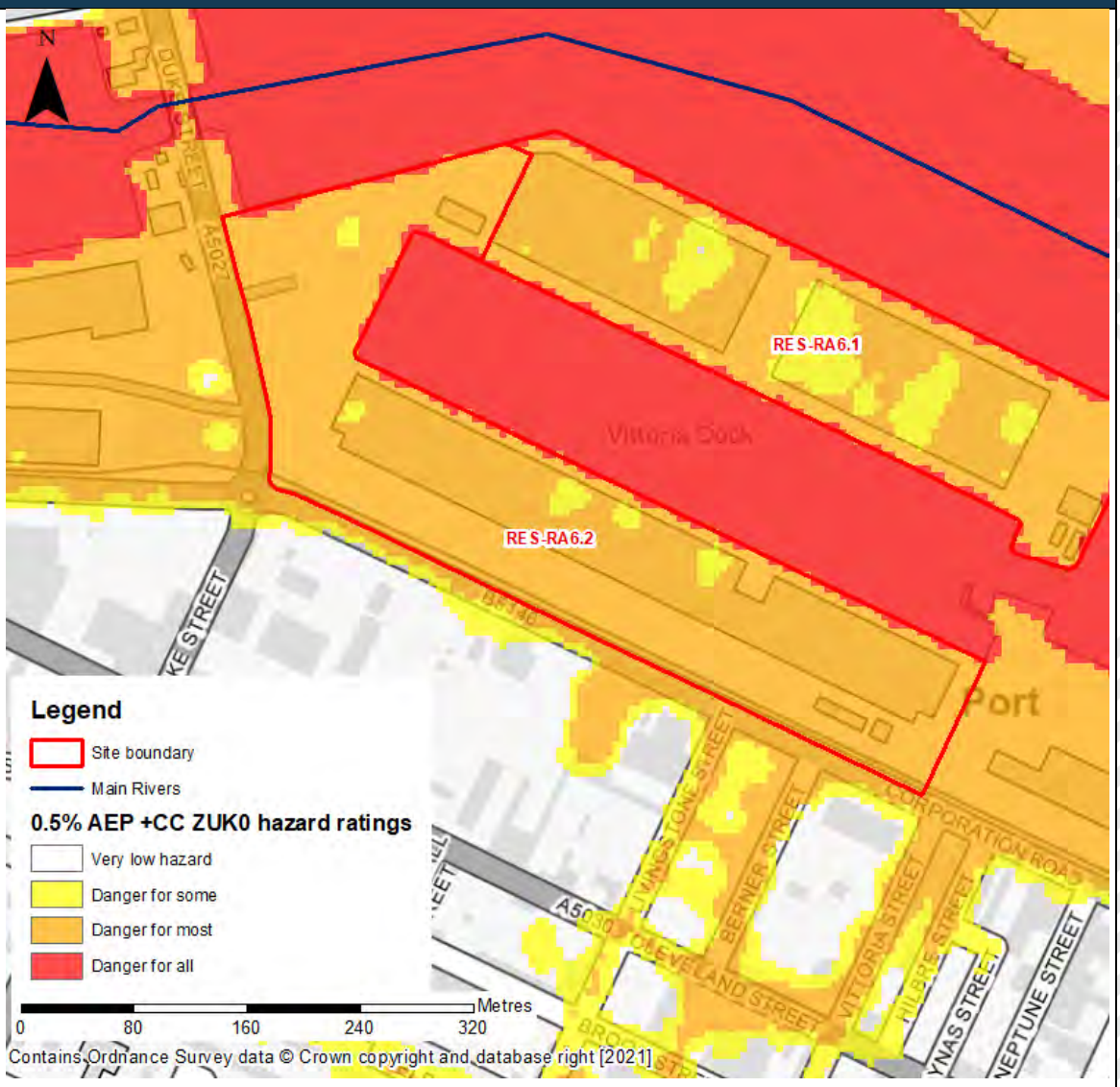
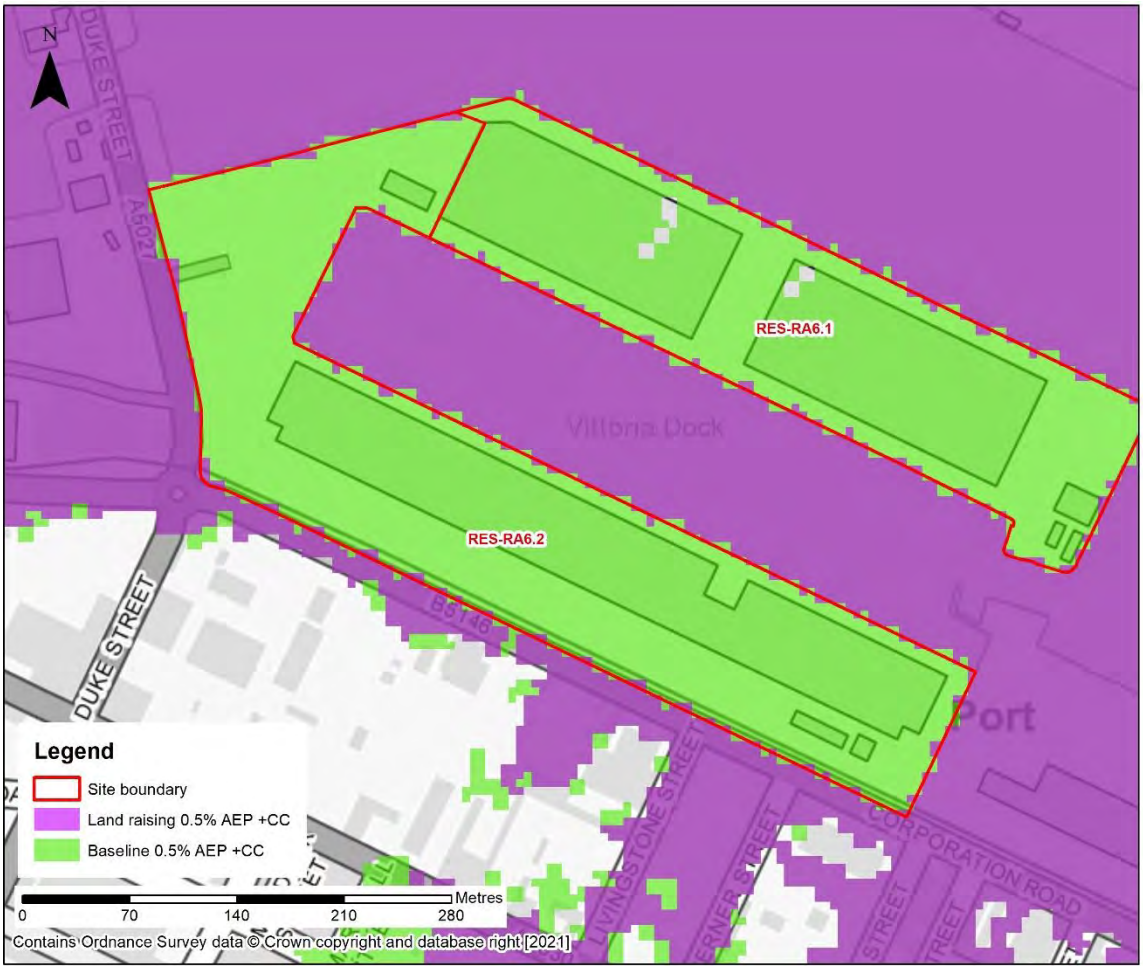


Figure 6: modelled tidal flood depths for 0.5% AEP + climate change event

Note: depth grid erased from open water to provide more accurate representation of flood depths onsite

RES-RA6.2: Wirral Waters – Vittoria Studios	
	 **Figure 7: modelled tidal flood hazard for 0.5% AEP +climate change event** **Tidal hazard ratings based on Table 4 of the SUPPLEMENTARY NOTE ON FLOOD HAZARD RATINGS AND THRESHOLDS FOR DEVELOPMENT PLANNING AND CONTROL PURPOSE – Clarification of the Table 13.1 of FD2320/TR2 and Figure 3.2 of FD2321/TR1. May 2008.* It is clear from the above figures that climate change will significantly impact the site in the long term with maximum depths of approximately 1 m and Danger for Most hazard ratings.
Tidal modelling: modelled land raising	
Modelled tidal risk including climate change on the coast with modelled land raising (Mersey	Given the significant risk exhibited at this site when accounting for climate change, it was considered necessary to model land raising of the site as a potential mitigation technique to gauge the offsite effects of this. A simple approach was applied whereby the whole site was uplifted to a set value to ensure the whole site was raised out of the flood zone. In reality, the terrain would be gently regraded and reformed to direct displaced water to, most likely, the adjacent docks. Any

RES-RA6.2: Wirral Waters – Vittoria Studios	
Estuary 2018 model)	FRA for the site should assess this further once site layout options are established. It should be noted that modelled outputs represent land raising at both this site and site RES-RA6.2. Therefore, any decisions made to raise the land at this site should be considered with land raising at the adjacent site RES-RA6.1. The elevation of the site was uplifted by 3.73 m to reflect the maximum levels for the 0.5% + CC (higher central) event +600 mm freeboard, as recommended by the EA. The updated maximum elevation within the site boundary therefore increased to 11.29 mAOD. Figure 8 shows the entire site to be flood free when compared to the baseline 0.5% AEP +CC extent in Figure 5. Depths to the south and west of the site have decreased by up to 0.2m in some places. This is likely due to a combination of increased floodwater storage within the docks between the two sites, and the raised land acting as an embankment to protect areas to the south and west from flooding. This indicates land raising would be beneficial to these areas that have existing industrial development. Site RES-RA6.1 has also been considered and remodelled to assess land raising and there has been no additional impact to this site. Hazard ratings to the south and west have improved, with more areas being categorised as 'Danger for some' rather than 'Danger for most' for the baseline.  **Figure 8: modelled tidal extents for the 0.5% AEP plus climate change land raising scenario**

RES-RA6.2: Wirral Waters – Vittoria Studios

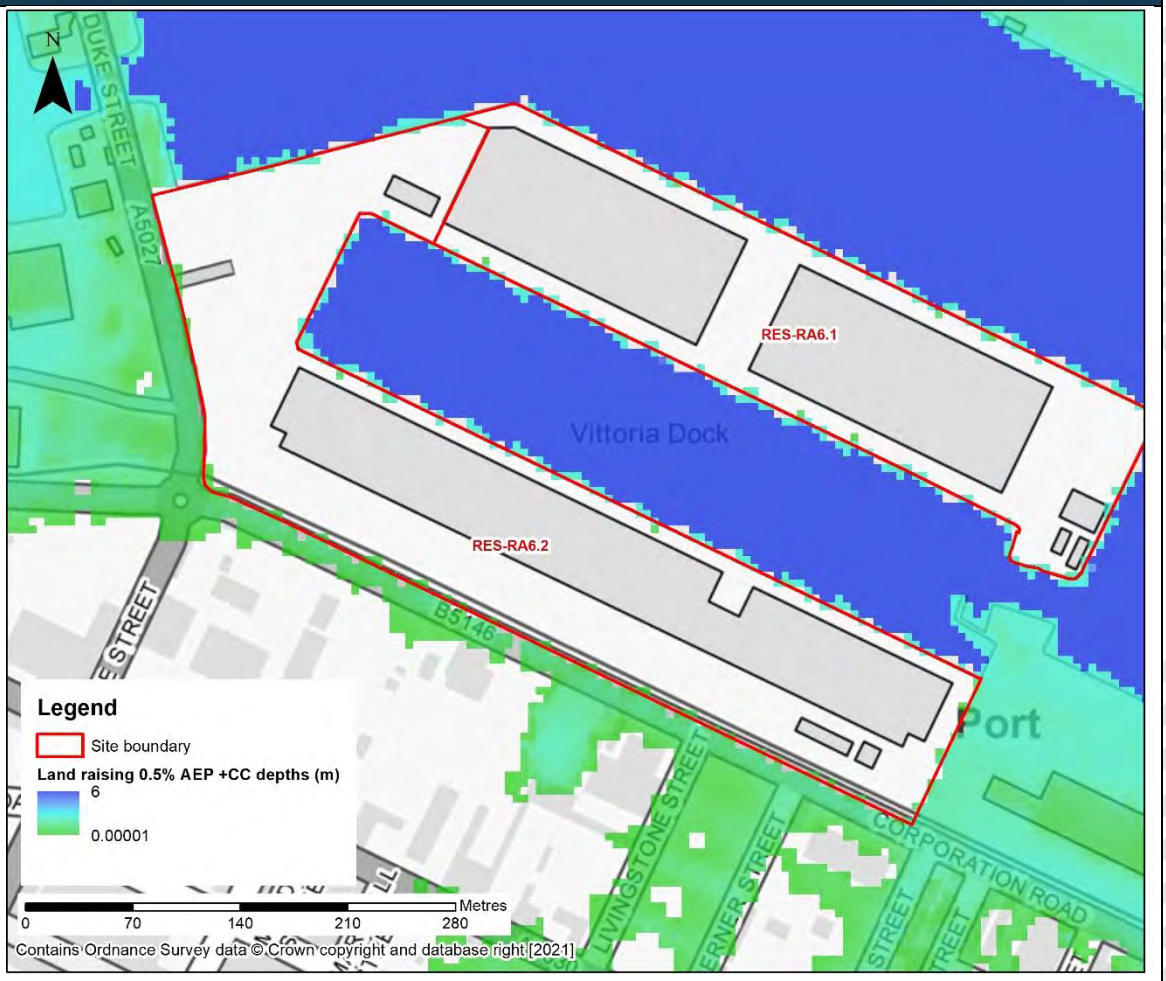
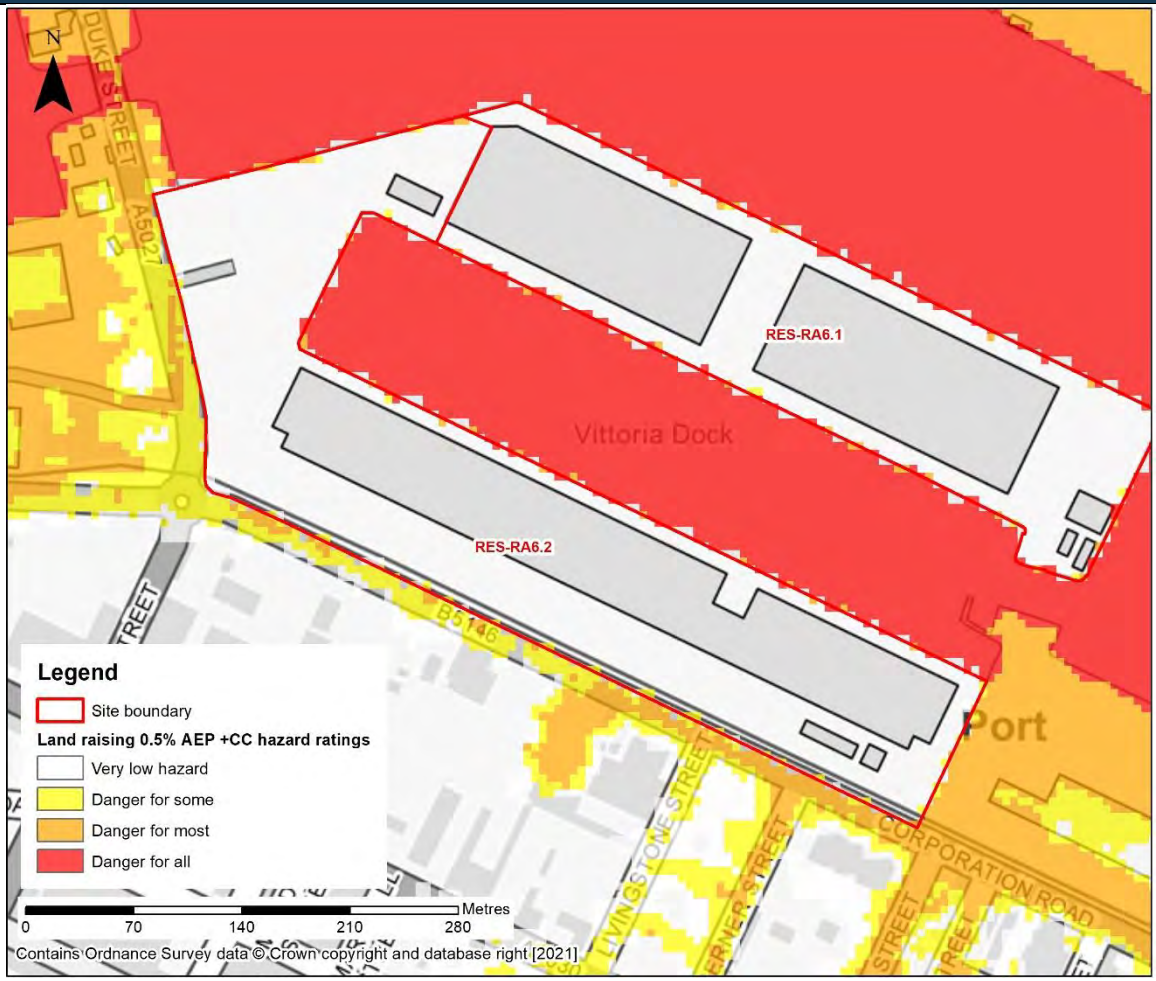


Figure 9: modelled tidal depths for the 0.5% AEP plus climate change land raising scenario

RES-RA6.2: Wirral Waters – Vittoria Studios	
	 **Figure 10: modelled tidal hazards for the 0.5% AEP plus climate change land raising scenario**
Historic flooding	There are no areas of historic flooding that affect the site according to the EA's Historic Flood Map (HFM) dataset.
Defences	There is no known flood defence infrastructure in the vicinity of the site.
Flood Warning Area	According to the EA's FWA dataset, there is a FWA for tidal flooding in operation for the west and a section of the east for the Irish Sea and Mersey Estuary from the Head of the Wirral to Runcorn.
Natural Flood Management / Working with Natural Process	The site lies outside the national scale 'potential for WwNP dataset', therefore there is no potential for natural flood management across the site.

RES-RA6.2: Wirral Waters – Vittoria Studios	
Observations, mitigation options & site suitability: tidal	- The proposed use of development would see a change in risk classification from less vulnerable to more vulnerable according to the NPPF. - Given the change in use and therefore vulnerability of the site, 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 change of use meets the objectives of the Framework'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). - Just over 33% of the site is located within fluvial Flood Zone 3a which covers the majority of the west and a section of the east of the site. However, The EA has confirmed that the risk in this area is dominated by tidal risk and fluvial risk is very low. It is likely the Flood Map for Planning will be updated in due course to reflect this - The Mersey Estuary 0.5% AEP event +CC outputs indicate the entire site is at risk of tidal flooding in the future, with maximum depths onsite of 1m. - Safe access and egress routes must be available at times of flooding. This will prove challenging as Duke Street and Corporation Road are entirely at risk from climate change with a hazard rating of danger for most. Any access routes would have to be raised above the 0.5% AEP event +climate change maximum level. Options for raised pedestrian footbridges over the East Float and Vittoria docks to areas outside the 0.5% AEP event +climate change extent should be explored. A FWA is in place however which should provide advanced warning for site users to evacuate ahead of a flood event. - Given the modelled risk from climate change and the difficulties with access and egress routes, it is recommended this site should not be developed for residential use. Ideally, this site would remain for less vulnerable uses with appropriate resilience measures put in place. - The modelled land raising scenario indicates raising the levels of the site to the 0.5% AEP +CC maximum level, plus 600mm freeboard, would protect the site from tidal flooding in the long term. However, raising the site above the required level of 3.89 m would represent a considerable undertaking. - Land raising at site RES-RA6.1 should be implemented with consideration of land raising at this stie. - Although land raising would be a viable option in protecting the site from tidal flooding, access and egress routes would still need to be available during times of flood, therefore raised escape route options should be investigated. - A Flood Risk Activity Permit may be required as the development of the site is within 16 metres of a tidal watercourse. Details on obtaining a Flood Risk Activity Permit are available from the EA. The EA also recommend for an 8m no development buffer alongside any watercourse to allow for maintenance access. - Were development of this site to proceed, given the proximity of this site to the neighbouring RES-RA6.1, it would be prudent to formulate a strategy to develop these sites in tandem and for consultation between each developer to take place to ensure a joined-up approach for sustainable development is in place, with consideration to the strategic solutions outlined in the Level 2 SFRA Summary Report.

RES-RA6.2: Wirral Waters – Vittoria Studios			
Flood source: infrastructure failure – reservoirs (residual)			
Flood risk: reservoir	There is no risk of flooding to the site as a result of dam failure, according to the EA's online RFM.		
Flood source: infrastructure failure – canals (residual)			
Flood risk: canal	There are no canals in the vicinity of the site.		
Flood source: surface water			
Surface Water Flood Risk to Proposed Development Site			
Current site: Risk of Flooding from Surface Water map	High Risk (3.3% AEP event)	Medium Risk (1% AEP event)	Low Risk (0.1% AEP event)
	0.3%	2.6%	14.9%
Surface water max flood depths	0.15 – 0.3 m	0.15 – 0.3 m	0.3 – 0.6 m

RES-RA6.2: Wirral Waters – Vittoria Studios

Figure 11: 1% AEP event surface water flood depths (Risk of Flooding from Surface Water map)

RES-RA6.2: Wirral Waters – Vittoria Studios

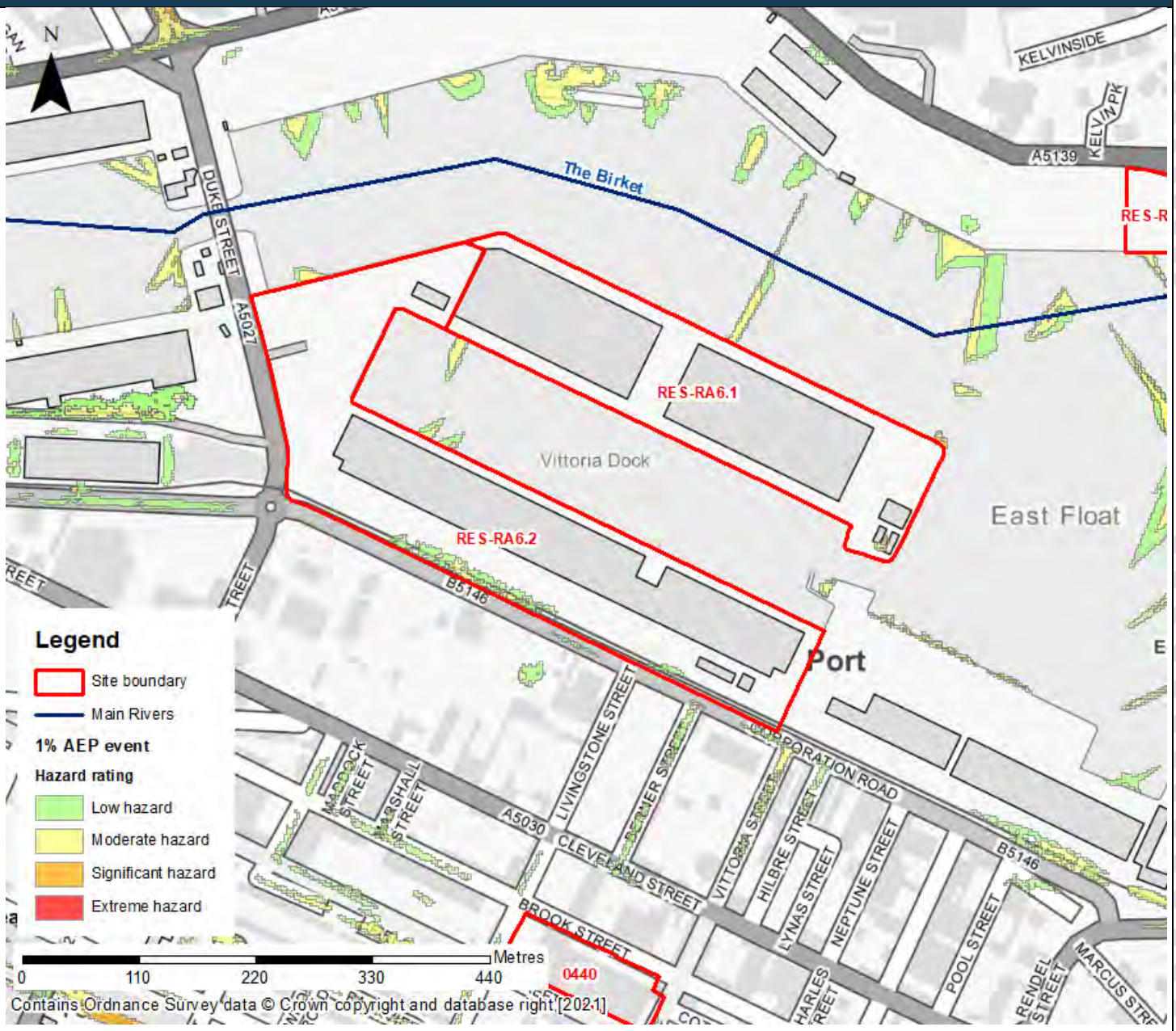


Figure 12: 1% AEP event surface water flood hazards (Risk of Flooding from Surface Water map)

**Surface water hazard rating based on Table 4.2 Hazard to People as a Function of Velocity and Depth, R&D OUTPUTS: FLOOD RISKS TO PEOPLE: PHASE 2 FD2321/TR2. Defra. March 2006.*

Surface water flood risk to development site	Nominal risk to the site and to access routes.
Climate change	The current day 0.1% AEP event outline provides an indication of the likely increase in extent of the more frequent events. The 0.1% AEP event outline covers approximately 15% of the total site area and the extent is localised to the southern area of the site, constrained by the existing building. Duke Street to the south west of the site remains free from inundation during the 0.1% AEP event and therefore would still be viable for safe site access

RES-RA6.2: Wirral Waters – Vittoria Studios						
	and egress.					
Observations, mitigation options & site suitability: surface water	- A full drainage strategy would be required to ensure there is no increase in surface water flood risk elsewhere as a result of new development and the assumed demolition of the current building on site. This may require surface water modelling based on proposed layout plans and full consultation with the LLFA. - Assessment of the current drainage system in place should be carried out to ascertain any current capacity issues and whether the current system could accommodate further development or whether further capacity will be required.					
Surface Water Flood Risk from Proposed Development						
Runoff rates should not exceed current rates and if possible, betterment of existing rates should be aimed for. For the purposes of this assessment, the required volumes of attenuation have been calculated below based on an assumed 85% impermeable area and limiting greenfield runoff rate of Qbar (l/s).						
Proposed development limiting runoff rate: (l/sec) Qbar: 42.56 l/s (FEH Statistical) Q30: 72.35 l/s Q100: 88.52 l/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
30yr Rainfall+20%	7.25	3678	778	2901	27	0.193 ha 2.660 %
30yr Rainfall+40%	8.75	4465	938	3526	32.8	0.235 ha 3.233 %
100yr Rainfall+20%	8.5	5107	912	4195 (1294 exceedance storage)	39	0.280 ha 3.847 %
100yr Rainfall+40%	10.25	6159	1099	5060 (1534 exceedance storage)	47	0.337 ha 4.640 %
Climate change	Application of the central (+20%) and upper end (+40%) allowances for potential change anticipated for the 2080s in the table above shows the estimated attenuation volumes for the 1% AEP and 3.33% AEP rainfall events.					
Surface water: flood risk impacts from development site, mitigation & SuDS	As part of this Level 2 SFRA we have included calculations to provide an estimated land take if a pond with an assumed depth of 1.5m was included as part of the development. Attenuation volumes are presented for the critical storm duration for the 3.33% AEP event with exceedance flows quantified up to the 1% event. To prevent development worsening flood risk elsewhere, surface water runoff must be managed on site.					

RES-RA6.2: Wirral Waters – Vittoria Studios	
Flood Source: Groundwater	
Flood risk: groundwater	 **Figure 13: Susceptibility of groundwater flooding (BGS national dataset)** Based on geological and hydrogeological information, the BGS dataset can be used to identify areas where geological conditions could enable groundwater flooding to occur and where groundwater may come close to the ground surface. The dataset should not be used on its own to make planning decisions at any scale and should not be used to inform planning decisions at the site scale. The susceptibility data cannot be used on its own to indicate risk of groundwater flooding. The dataset shows that the majority of the site is not prone to groundwater flooding.

RES-RA6.2: Wirral Waters – Vittoria Studios	
Overall Site Assessment	
Access and egress	Safe access and egress will be difficult to achieve in the long-term due to significant tidal risk.
Recommendation summary	Based on the evidence presented in the Level 1 SFRA and this Level 2 SFRA: - Early discussions should take place with the EA with regards to the tidal flood risk issues on this site. The EA offers early engagement through an advisory service via their website (https://www.gov.uk/guidance/developers-get-environmental-advice-on-your-planning-proposals) or by emailing the local office: SPPlanning.RFH@environment-agency.gov.uk. - It is recommended that this site should not be developed for residential use given the significant long-term risk with climate change. The site should remain for less vulnerable uses with resilience measures in place. - Modelled land raising scenarios indicate that this could be an option to protect the site from long term tidal flooding. This should be explored at the FRA stage. - No development within 8 m of The Birket/West Float.
Can the second part of the Exception Test be satisfied?	To pass the Exception Test, it must be proven that the site can be safe for its lifetime, which for residential development is 100 years. The climate change modelling in this Level 2 SFRA shows this will not be possible. However, land raising may be a viable option and should be explored further at the FRA stage.
FRA requirements	- The FRA should assess the options for raised pedestrian routes to ensure safe access and egress to the site. - Full consideration should be given to the impact development may have on the adjacent site RES-RA6.1. - The FRA should include emergency planning procedures and ensure safe access and egress routes in times of flood. - Any FRA should be carried out in line with the NPPF; FRCC-PPG; Local Plan and LLFA policies; and national and local SuDS policy and guidelines. - Throughout the FRA process, consultation should be carried out with the following, where applicable, the LPA; LLFA; emergency planning officers; EA; UU; the highways authorities; and the emergency services.

Offices at

Coleshill
Doncaster
Dublin
Edinburgh
Exeter
Glasgow
Haywards Heath
Isle of Man
Limerick
Newcastle upon Tyne
Newport
Peterborough
Saltaire
Skipton
Tadcaster
Thirsk
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Wirral Level 2 Strategic Flood Risk Assessment

Site RES-RA6.5

Final Report

April 2022

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Revision History

Revision Ref / Date	Amendments	Issued to
V1.0 Draft September 2021	-	John Entwistle
V2.0 Final February 2022	Council and EA comments addressed	John Entwistle
V3.0 Final April 2022	Site boundary amended	John Entwistle

Prepared by ..... Hannah Bishop BSc MSc

Assistant Analyst

Reviewed by ..... Mike Williamson BSc MSc CGeog FRGS EADA

Principal Flood Risk Analyst

Purpose

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Abbreviations

AOD	Above Ordnance Datum
BGS	British Geological Survey
EA	Environment Agency
FRCC-PPG	Flood Risk and Coastal Change Planning Practice Guidance
FMfP	Flood Map for Planning
FAA	Flood Alert Area
FRA	Flood Risk Assessment
FWA	Flood Warning Area
HFM	Historic Flood Map
LIDAR	Light Detection and Radar
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
NPPF	National Planning Policy Framework
RFM	Reservoir Flood Map
RoFSW	Risk of Flooding from Surface Water
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Drainage Systems
UU	United Utilities
WFD	Water Framework Directive

RES-RA6.5: Wirral Waters – Northbank East 3	
Location	Tower Road, Seacombe
Site area (ha)	0.56
Watercourse	The Birket/East Float
EA Model used	Mersey Estuary 2018 (includes tidal Birket)
Existing use	Industrial and brownfield
Existing site flood risk vulnerability classification (NPPF)	Less vulnerable
Proposed use	Residential
Proposed development flood risk vulnerability classification (NPPF)	More vulnerable
Proposed development impermeable area (ha)	0.48
Note: there has been an amendment to the boundary of site RES-RA6.5 since this Level 2 SFRA was produced, however flood risk to the site and subsequent recommendations have not changed.	

RES-RA6.5: Wirral Waters – Northbank East 3

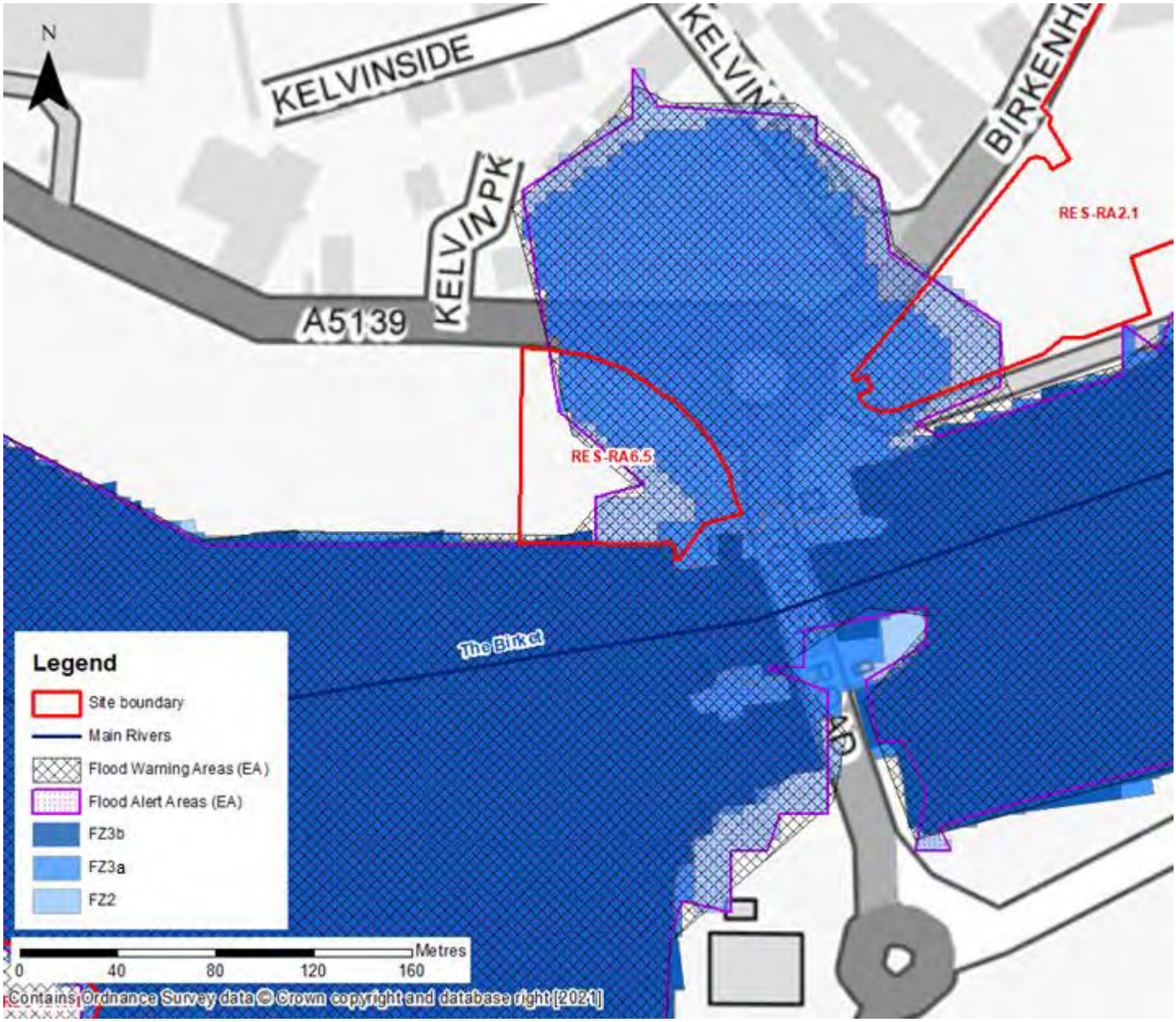


Figure 1: Existing fluvial and tidal flood zones, and flood risk data

This site is situated just to the north of the Main River The Birket, also referred to as the East Float dock. The eastern portion of the site is within fluvial Flood Zone 3a, according to the Flood Map for Planning. The EA has confirmed that the risk in this area is dominated by tidal risk and fluvial risk is very low. It is likely the Flood Map for Planning will be updated in due course to reflect this. The majority of the site is located within a FWA and FAA.

RES-RA6.5: Wirral Waters – Northbank East 3

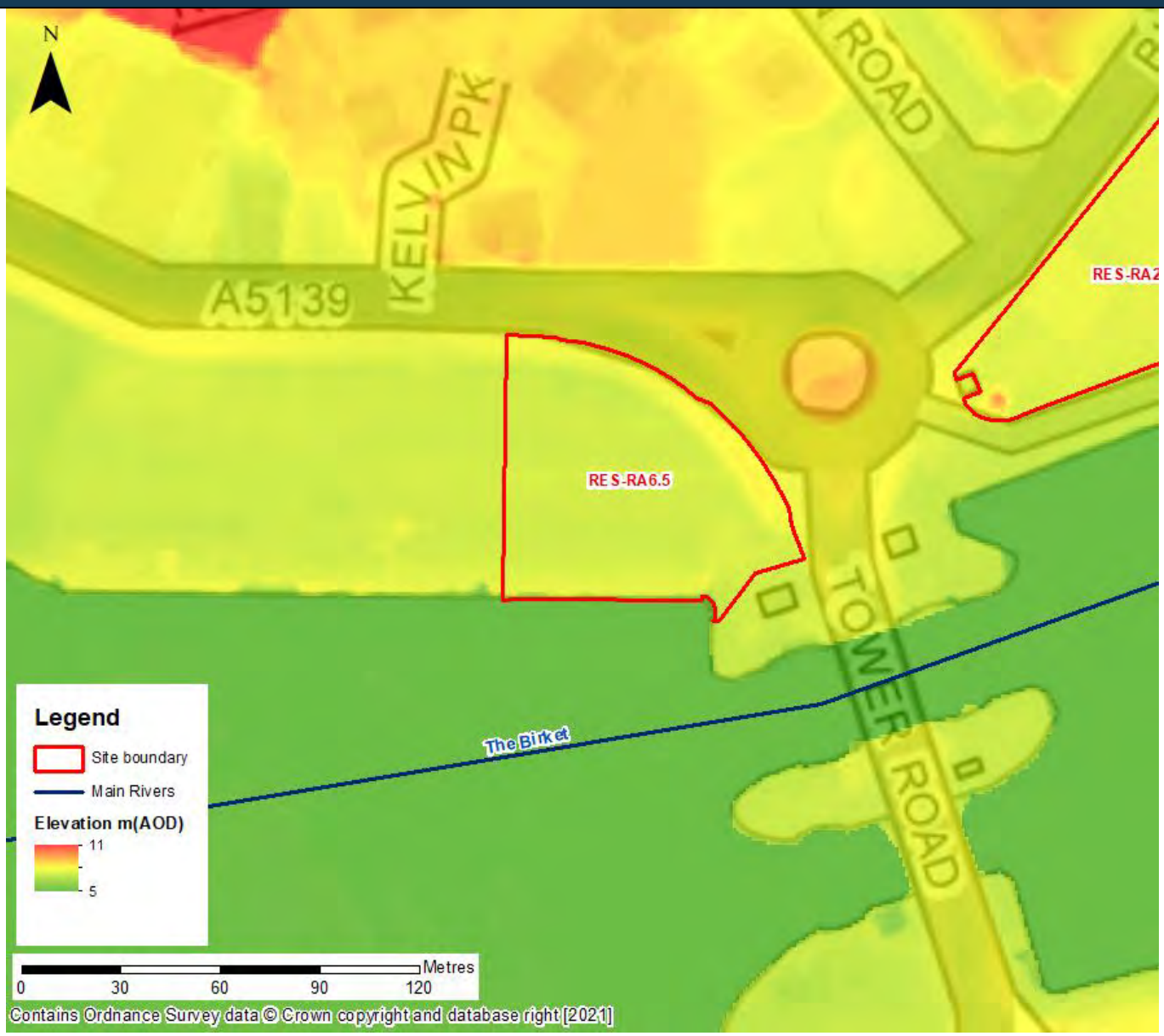


Figure 2: Topography

The elevation across the whole site does not vary substantially remaining around 7 m AOD. The area of water at East Float to the south of the site has a lower elevation of approximately 5 m AOD.

Flood Source: Tidal

Flood Zones	Flood Zone 3b	Flood Zone 3b +climate change*	Flood Zone 3a	Flood Zone 3a +climate change*	Flood Zone 2
	1.5%	+2.7%	42.4%	+13.7%	17.2%
Tidal: maximum depth	Not available	N/A (within waterbody)	N/A (within waterbody)	0.6 m	Not available

Flood Zone 3b figures stated based on defended model; Flood Zone 3a and 2 figures stated based on undefended model

*Climate change figures based on 70th percentile (higher central allowance)

RES-RA6.5: Wirral Waters – Northbank East 3	
Modelled tidal risk including climate change (Mersey Estuary 2018 model) NOTE: modelled outputs for this SFRA are subtly different to original 2018 modelled outputs due to upgraded modelling and GIS software	 **Figure 3: modelled tidal flood outline for present day 0.5% AEP event** NOTE: the modelling outputs presented at this site are from the Mersey Estuary 2018 coastal model only. Although Flood Zone 3 (Figure 1) on the site is stated as fluvial, the modelled outputs are tidal only, hence the difference in Flood Zone 3a in Figure 1 and the modelled tidal 0.5% AEP event outline shown above in Figure 3. However, the risk to the site in the long term is dominated by tidal flooding, as shown in Figure 4 below. The EA has also confirmed that fluvial risk in this area is very low.

RES-RA6.5: Wirral Waters – Northbank East 3

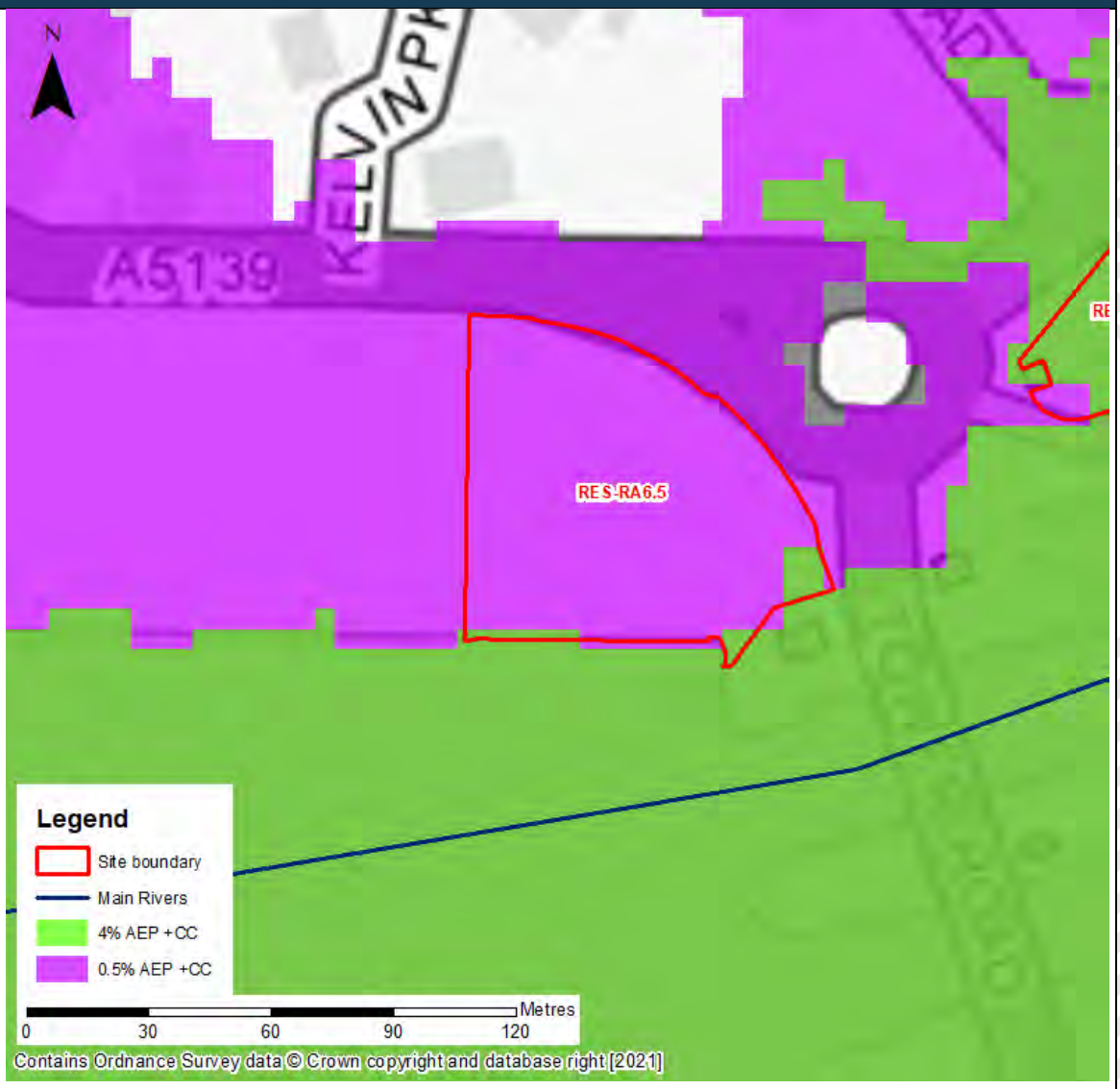


Figure 4: modelled tidal flood outlines for higher central climate change allowance

RES-RA6.5: Wirral Waters – Northbank East 3

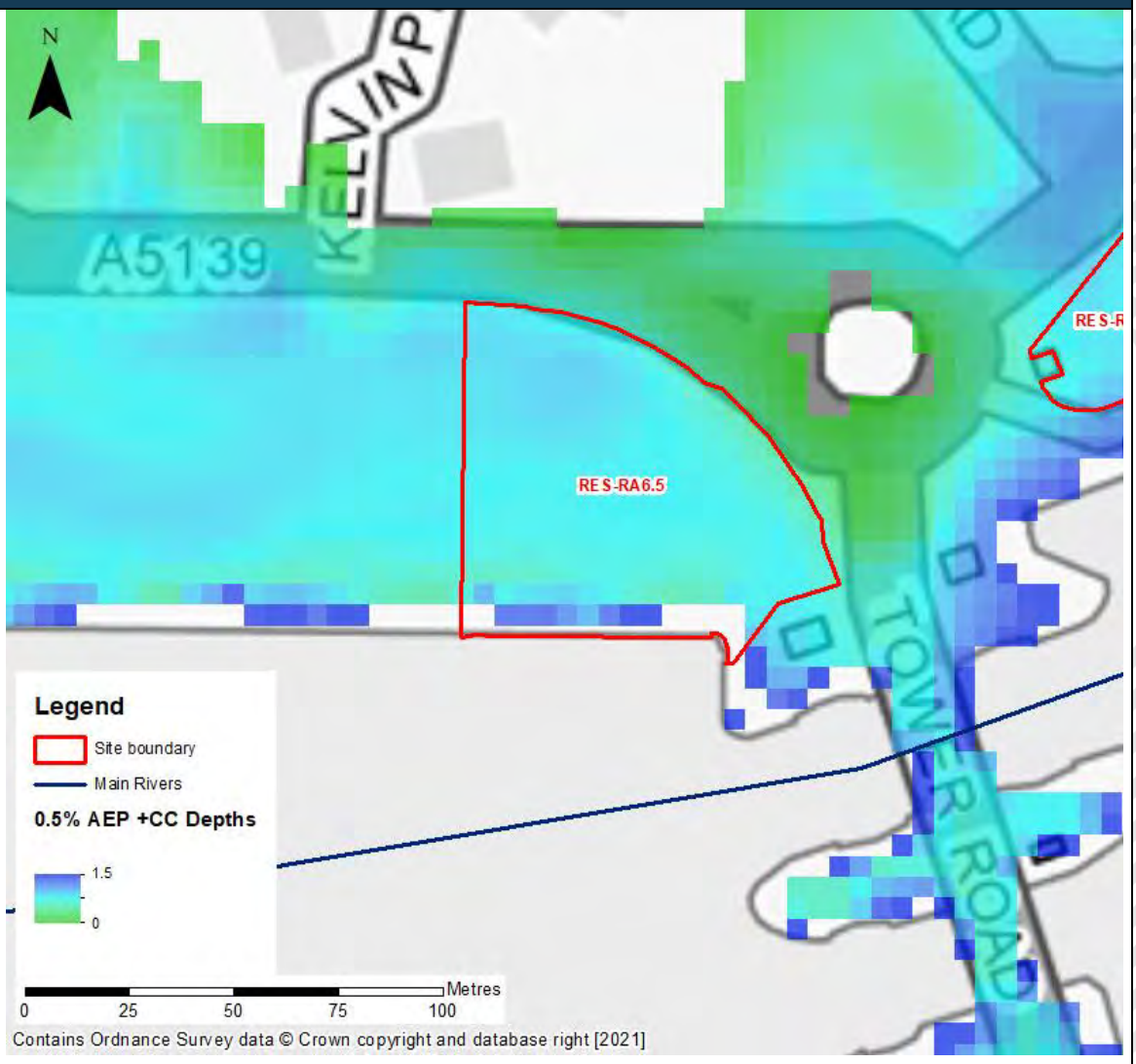
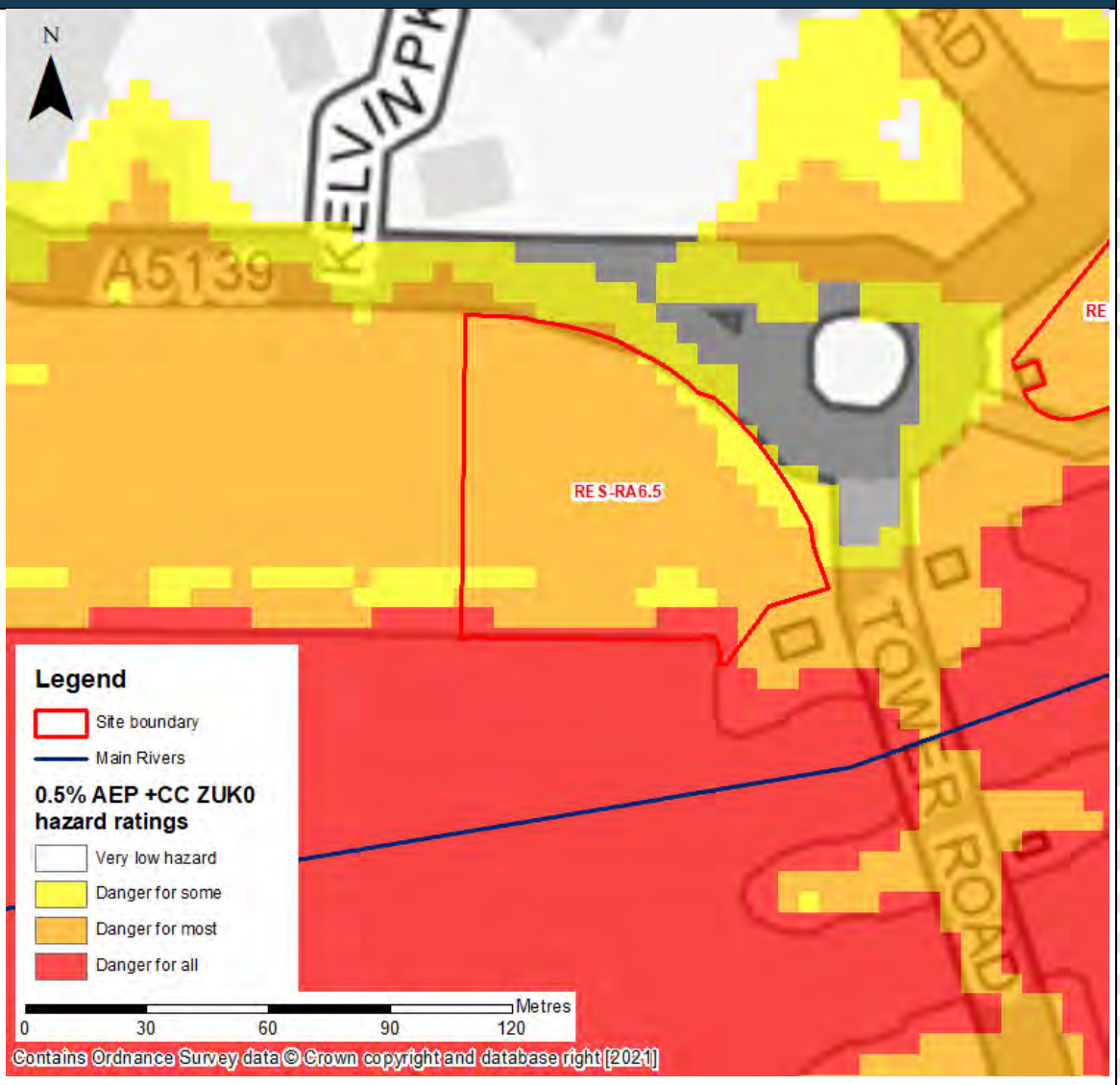
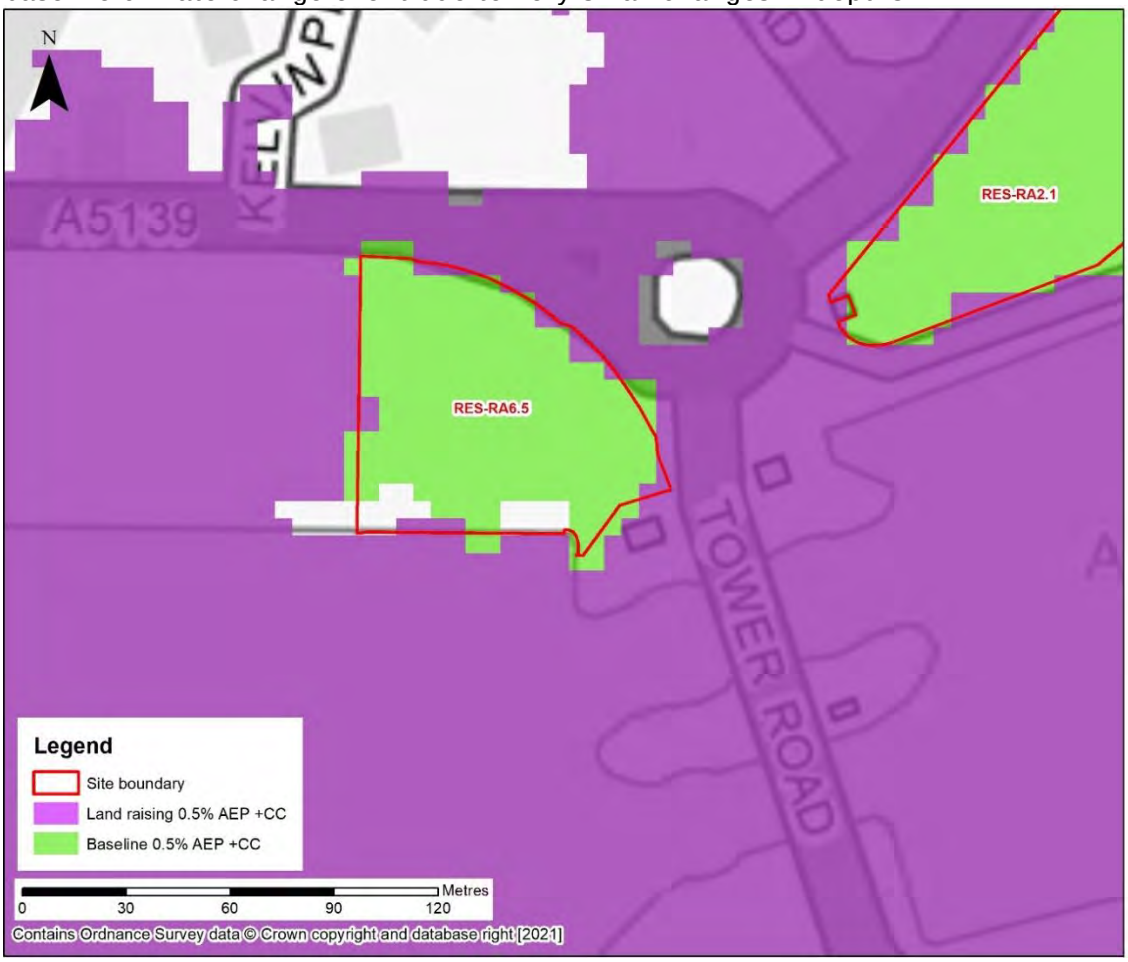


Figure 5: modelled tidal flood depths for 0.5% AEP + climate change event

Note: depth grid erased from open water to provide more accurate representation of flood depths onsite

RES-RA6.5: Wirral Waters – Northbank East 3	
	 **Figure 6: modelled tidal flood hazard for 0.5% AEP +climate change event** **Tidal hazard ratings based on Table 4 of the SUPPLEMENTARY NOTE ON FLOOD HAZARD RATINGS AND THRESHOLDS FOR DEVELOPMENT PLANNING AND CONTROL PURPOSE – Clarification of the Table 13.1 of FD2320/TR2 and Figure 3.2 of FD2321/TR1. May 2008.* Climate change will significantly impact the entire site in the long term with maximum depths of approximately 0.6 m and Danger for Most hazard ratings for the 0.5% AEP plus climate change event.
Tidal modelling: modelled land raising	
Modelled tidal risk including climate change on the coast with modelled land raising (Mersey	Given the significant risk exhibited at this site when accounting for climate change, it was considered necessary to model land raising of the site as a potential mitigation technique to gauge the offsite effects of this. A simple approach was applied whereby the whole site was uplifted to a set value to ensure the whole site was raised out of the flood zone. In reality, the terrain would be gently regraded and reformed to direct displaced water to, most likely, the adjacent Mersey Estuary.

RES-RA6.5: Wirral Waters – Northbank East 3	
Estuary 2018 model)	Any FRA for the site should assess this further once site layout options are established. It should be noted that modelled outputs represent land raising at both this site and site RES-RA2.1. Therefore, any decisions made to raise the land at this site should be considered with land raising at the adjacent site RES-RA2.1. The elevation of the site was uplifted by 3.6 m to reflect the maximum levels for the 0.5% + CC (higher central) event +600 mm freeboard, as recommended by the EA. The updated maximum elevation within the site boundary therefore increased to 11.25 mAOD. Figure 7 shows the entire site to be flood free when compared to the baseline 0.5% AEP +CC extent in Figure 4. As a result of land raising, modelled depths to the west and south of the site remain largely similar to the baseline climate change scenario, with depths on average increasing only by around 10mm. Modelled depths to the north and east of the site have increased by around 20-60mm following land raising at site RES-RA6.5. Towards site RES-RA2.1 modelled land raising depths begin to decrease in comparison to the baseline. This decrease in depths to the north east is likely a result of the raised land at site RES-RA2.1 acting as a barrier to constrain additional floodwater from the east. Hazard ratings in the area surrounding the site remain largely similar to the baseline climate change event due to very small changes in depths.  **Figure 7: modelled tidal extents for the 0.5% AEP plus climate change land raising scenario**

RES-RA6.5: Wirral Waters – Northbank East 3

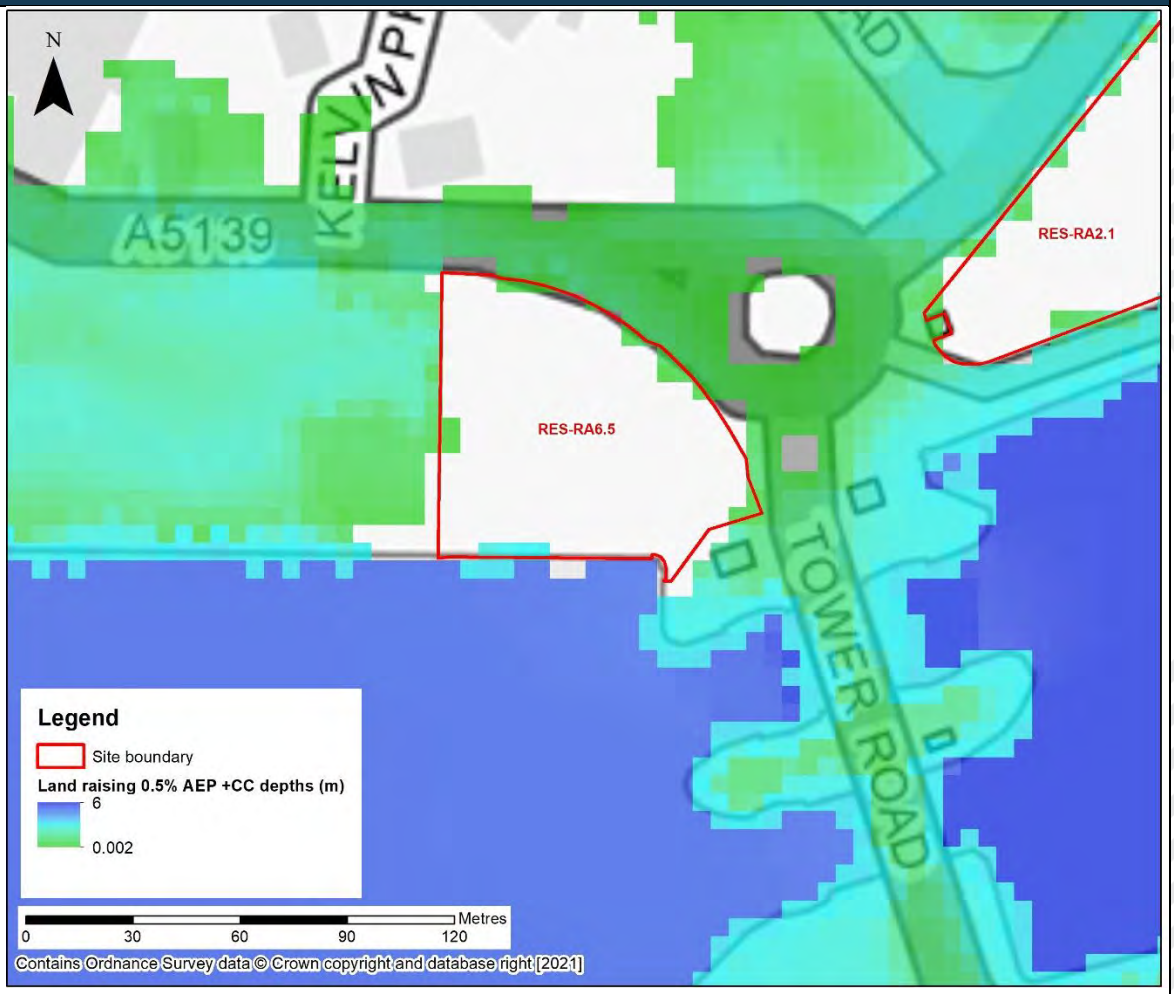
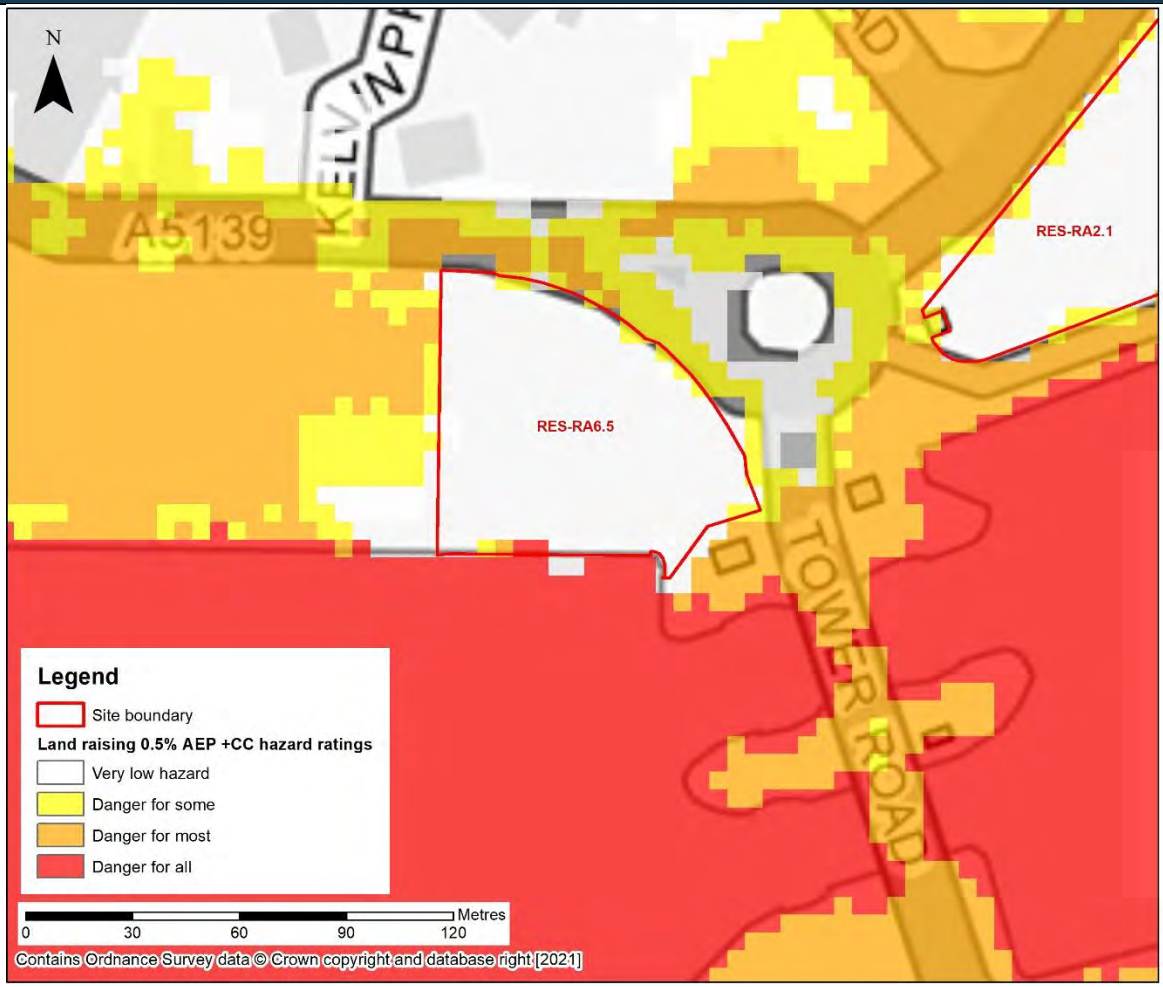
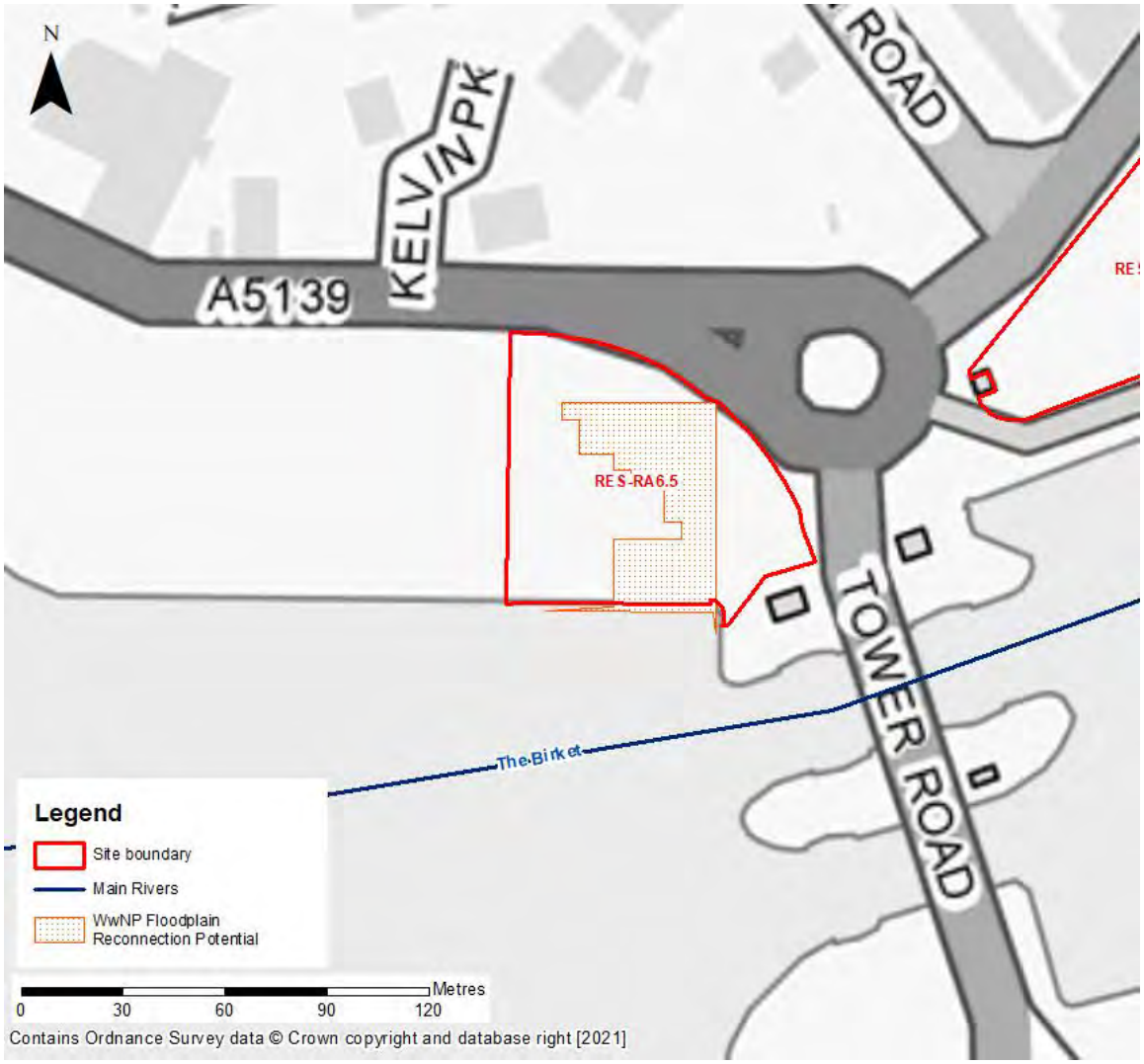


Figure 8: modelled tidal depths for the 0.5% AEP plus climate change land raising scenario

RES-RA6.5: Wirral Waters – Northbank East 3	
	 **Figure 9: modelled tidal hazards for the 0.5% AEP plus climate change land raising scenario**
Historic flooding	There are no areas of historic flooding that affect the site according to the EA's Historic Flood Map (HFM) dataset.
Defences	There is no known flood defence infrastructure in the vicinity of the site.
Flood Warning Area	According to the EA's FWA dataset, there is a FWA in operation for the majority of the site to the east for the Irish Sea and Mersey Estuary from the Head of the Wirral to Runcorn.

RES-RA6.5: Wirral Waters – Northbank East 3	
Natural Flood Management / Working with Natural Process	 **Figure 10: Areas identified as potential for floodplain reconnection (Working with Natural Processes)** According to the national scale 'potential for WwNP dataset', the area of flood risk in the centre of the site has potential for floodplain reconnection i.e. returning this area to the floodplain for flood alleviation purposes.
Observations, mitigation options & site suitability: tidal	- The proposed use of development would see a change in risk classification from less vulnerable to more vulnerable according to the NPPF. - Given the change in use and therefore vulnerability of the site, 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 change of use meets the objectives of the Framework'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). - Just over 42% of the site is shown by the Flood Map for Planning to be located within fluvial Flood Zone 3a which covers the majority of the eastern area of the site. However, the EA has confirmed that the risk in this area is dominated

RES-RA6.5: Wirral Waters – Northbank East 3	
	by tidal risk and fluvial risk is very low. It is likely the Flood Map for Planning will be updated in due course to reflect this. - The Mersey Estuary 0.5% AEP event +CC outputs indicate the entire site is at significant risk from tidal flooding in the future, with maximum depths onsite of 0.6m. - Safe access and egress routes must be available at times of flooding. In the long-term, the 0.5% AEP +climate change tidal event is modelled to flood the A5139 to a maximum depth of 0.6 m and therefore may prove difficult for safe access and egress in the future. Any access routes would have to be raised above the 0.5% AEP event +climate change maximum level. A FWA is in place however which should provide advanced warning for site users to evacuate ahead of a present-day flood event. - Given the modelled risk from climate change and the difficulties with access and egress routes, it is recommended this site should not be developed for residential use. Ideally, this site would remain for less vulnerable uses with appropriate resilience measures put in place or be used as a multifunctional greenspace for flood storage, amenity use and to provide environmental/ecological benefits. - The modelled land raising scenario indicates raising the levels of the site to the 0.5% AEP +CC maximum level, plus 600mm freeboard, would protect the site from tidal flooding in the long term. However, raising the site above the required level of 3.6 m would represent a considerable undertaking - The modelled depths to the south and west of the site have increased by around 10mm. Depths to the north have been modelled to increase by around 20-600mm. Depths to the north east have been modelled to decrease slightly with land raising. This decrease in depths to the north east is likely a result of the raised land at site RES-RA2.1 acting as a barrier to constrain additional floodwater from the east. - Although land raising would be a viable option in protecting the site from tidal flooding, access and egress routes would still need to be available during times of flood, therefore raised escape route options should be investigated. - Stilted development may be an option though is likely to be an expensive design solution with access and egress routes also required to be above the design flood level. - A further option may be for ground floor parking or other less vulnerable uses (i.e. non-residential such as shops, restaurants, offices) and for habitable dwellings to be situated on first floor and upwards. However, safe access and egress routes must be available at times of flood, even for above ground floor accommodation. - A flood risk activity permit may be required given the proximity of the site being within 16 metres of the tidally influenced Birket Main River. Details on obtaining a Flood Risk Activity Permit are available from the EA. Also, the EA advises against development within 8m of any watercourse to enable access for maintenance works. - Based on the evidence stated, it is recommended that this site is not developed and is instead used for less vulnerable uses. However, there are options to allow residential development which include land raising or stilted development, as discussed above. In any case, safe access/egress must be available during a flood event. - Were development of this site to proceed, given the proximity of this site to the neighbouring RES-RA2.1, it would be prudent to formulate a strategy to develop these sites in tandem and for consultation between each developer to

<table>
<tr><th colspan="4">RES-RA6.5: Wirral Waters – Northbank East 3</th></tr>
<tr><td></td><td colspan="3">take place to ensure a joined-up approach for sustainable development is in place, with consideration to the strategic solutions outlined in the Level 2 SFRA Summary Report.</td></tr>
<tr><th colspan="4">Flood source: infrastructure failure – reservoirs (residual)</th></tr>
<tr><td>Flood risk: reservoir</td><td colspan="3">There is no risk of flooding to the site as a result of dam failure, according to the EA's online RFM.</td></tr>
<tr><th colspan="4">Flood source: infrastructure failure – canals (residual)</th></tr>
<tr><td>Flood risk: canal</td><td colspan="3">There are no canals in the vicinity of the site.</td></tr>
<tr><th colspan="4">Flood source: surface water</th></tr>
<tr><td colspan="4">Surface Water Flood Risk to Proposed Development Site</td></tr>
<tr><td rowspan="2">Current site: Risk of Flooding from Surface Water map</td><td>High Risk
(3.3% AEP event)</td><td>Medium Risk
(1% AEP event)</td><td>Low Risk
(0.1% AEP event)</td></tr>
<tr><td>0%</td><td>0%</td><td>0.4%</td></tr>
<tr><td>Surface water max flood depths</td><td>Not applicable</td><td>Not applicable</td><td>Not applicable</td></tr>
<tr><td>Surface water flood risk to development site</td><td colspan="3">Surface water risk onsite and to access points is nominal.</td></tr>
<tr><td>Climate change</td><td colspan="3">Nominal risk as above.</td></tr>
<tr><td>Observations, mitigation options & site suitability: surface water</td><td colspan="3">- Nominal risk to site and access points.
- Drainage strategy for the site would still be required including consultation with the LLFA.</td></tr>
</table>

RES-RA6.5: Wirral Waters – Northbank East 3						
Surface Water Flood Risk from Proposed Development						
Runoff rates should not exceed current rates and if possible, betterment of existing rates should be aimed for. For the purposes of this assessment, the required volumes of attenuation have been calculated below based on an assumed 85% impermeable area and limiting greenfield runoff rate of Qbar (l/s).						
Proposed development limiting runoff rate: (l/sec) Qbar: 3.36 l/s (assume 5 l/s minimum discharge) (FEH Statistical) Q30: 5.72 l/s Q100: 6.99 l/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
30yr Rainfall+20%	4.75	258	60	198	15.7	0.013 ha 2.357 %
30yr Rainfall+40%	5.75	315	72	242	19.2	0.016 ha 2.881 %
100yr Rainfall+20%	6	369	76	294 (96 exceedance storage)	23.2	0.020 ha 3.500 %
100yr Rainfall+40%	7	444	88	356 (114 exceedance storage)	28.2	0.024 ha 4.238 %
Climate change	Application of the central (+20%) and upper end (+40%) allowances for potential change anticipated for the 2080s in the table above shows the estimated attenuation volumes for the 1% AEP and 3.33% AEP rainfall events.					
Surface water: flood risk impacts from development site, mitigation & SuDS	As part of this Level 2 SFRA we have included calculations to provide an estimated land take if a pond with an assumed depth of 1.5m was included as part of the development. Attenuation volumes are presented for the critical storm duration for the 3.33% AEP event with exceedance flows quantified up to the 1% event. To prevent development worsening flood risk elsewhere, surface water runoff must be managed on site.					

RES-RA6.5: Wirral Waters – Northbank East 3	
Flood Source: Groundwater	
Flood risk: groundwater	 **Figure 11: Susceptibility of groundwater flooding (BGS national dataset)** Based on geological and hydrogeological information, the BGS dataset can be used to identify areas where geological conditions could enable groundwater flooding to occur and where groundwater may come close to the ground surface. The dataset should not be used on its own to make planning decisions at any scale and should not be used to inform planning decisions at the site scale. The susceptibility data cannot be used on its own to indicate risk of groundwater flooding. The dataset shows that the site is not prone to groundwater flooding.
Overall Site Assessment	
Access and egress	Safe access and egress would not be achievable in the long term due to climate change. Escape routes must remain dry at all times therefore raised walkways above a design flood level plus some freeboard would be required.

RES-RA6.5: Wirral Waters – Northbank East 3	
Recommendation summary	Based on the evidence presented in the Level 1 SFRA and this Level 2 SFRA: - Early discussions should take place with the EA with regards to the tidal flood risk issues on this site. The EA offers early engagement through an advisory service via their website (https://www.gov.uk/guidance/developers-get-environmental-advice-on-your-planning-proposals) or by emailing the local office: SPPlanning.RFH@environment-agency.gov.uk. - It is recommended that this site should not be developed for residential use given the significant long-term risk with climate change. The site should remain for less vulnerable uses with resilience measures in place or alternatively left as open space and converted to multifunctional amenity greenspace providing flood storage and social and environmental benefits. - Land raising may be a viable option to protect the site from tidal flooding in the long term. This should be explored at the FRA stage. - Any consideration for development must fully investigate the options presented in this Level 2 SFRA, including for the provision of safe access and egress routes.
Can the second part of the Exception Test be satisfied?	To pass the Exception Test, it must be proven that the site can be safe for its lifetime, which for residential development is 100 years. The climate change modelling in this Level 2 SFRA shows this will not be possible. However, land raising may be a viable option and should be explored further at the FRA stage.
FRA requirements	- For development to proceed, the FRA must show the development can be safe for its lifetime and must not increase risk elsewhere. - Full consideration should be given to the impact development may have on the adjacent site RES-RA2.1, including any land raising. - The FRA should include emergency planning procedures and ensure safe access and egress routes in times of flood. - Any FRA should be carried out in line with the NPPF; FRCC-PPG; Local Plan and LLFA policies; and national and local SuDS policy and guidelines. - Throughout the FRA process, consultation should be carried out with the following, where applicable, the LPA; LLFA; emergency planning officers; EA; UU; the highways authorities; and the emergency services.

Offices at

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Edinburgh
Exeter
Glasgow
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Isle of Man
Limerick
Newcastle upon Tyne
Newport
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Skipton
Tadcaster
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Wirral Level 2 Strategic Flood Risk Assessment

Site RES-SA4.6

Final Report

April 2022

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WIRRAL

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Revision History

Revision Ref / Date	Amendments	Issued to
V1.0 Draft September 2021	-	John Entwistle
V2.0 Draft December 2021	Council and EA comments addressed	John Entwistle
V2.0 Final February 2022	-	John Entwistle
V3.0 Final April 2022	Site boundary amended	John Entwistle

Prepared by ..... Maria Botterill BSc

Analyst

Reviewed by ..... Mike Williamson BSc MSc CGeog FRGS EADA

Principal Flood Risk Analyst

Purpose

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Abbreviations

AOD	Above Ordnance Datum
BGS	British Geological Survey
EA	Environment Agency
FRCC-PPG	Flood Risk and Coastal Change Planning Practice Guidance
FMfP	Flood Map for Planning
FAA	Flood Alert Area
FRA	Flood Risk Assessment
FWA	Flood Warning Area
HFM	Historic Flood Map
LIDAR	Light Detection and Radar
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
NPPF	National Planning Policy Framework
RFM	Reservoir Flood Map
RoFSW	Risk of Flooding from Surface Water
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Drainage Systems
UU	United Utilities
WFD	Water Framework Directive

RES-SA4.6, Former Croda, Bromborough Pool	
Location	Bromborough
Site area (ha)	4.6
Watercourse	Dibbinsdale Brook
EA Model used	Mersey Estuary 2018 Model
Existing use	Brownfield
Existing site flood risk vulnerability classification (NPPF)	Less vulnerable
Proposed use	Residential
Proposed development flood risk vulnerability classification (NPPF)	More vulnerable
Proposed development impermeable area (ha)	3.9
Note: there has been a minor amendment to the southern boundary of this site since this Level 2 SFRA was produced, however flood risk to the site and subsequent recommendations have not changed.	

RES-SA4.6, Former Croda, Bromborough Pool

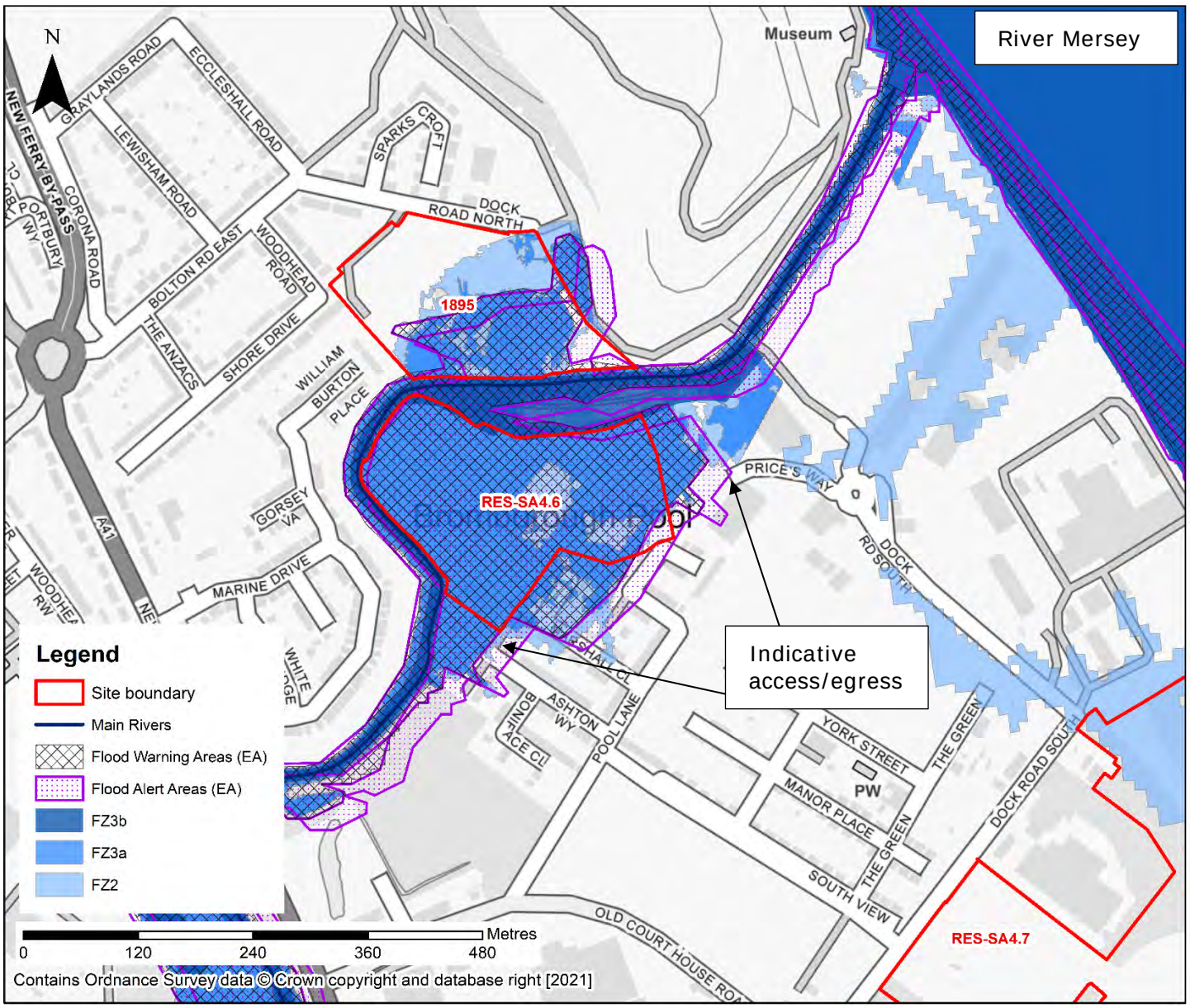


Figure 1: Existing tidal flood zones and flood risk data

The site lies adjacent to the Mersey Estuary and Dibbinsdale Brook runs alongside the north and west boundary of the site. The site lies mainly within tidal Flood Zone 3a, although the boundary adjacent to the Brook is within Flood Zone 3b. A FWA and FAA are in place across the site for flooding from Dibbinsdale Brook. There is no mapped historic flooding within the vicinity of the site.

RES-SA4.6, Former Croda, Bromborough Pool

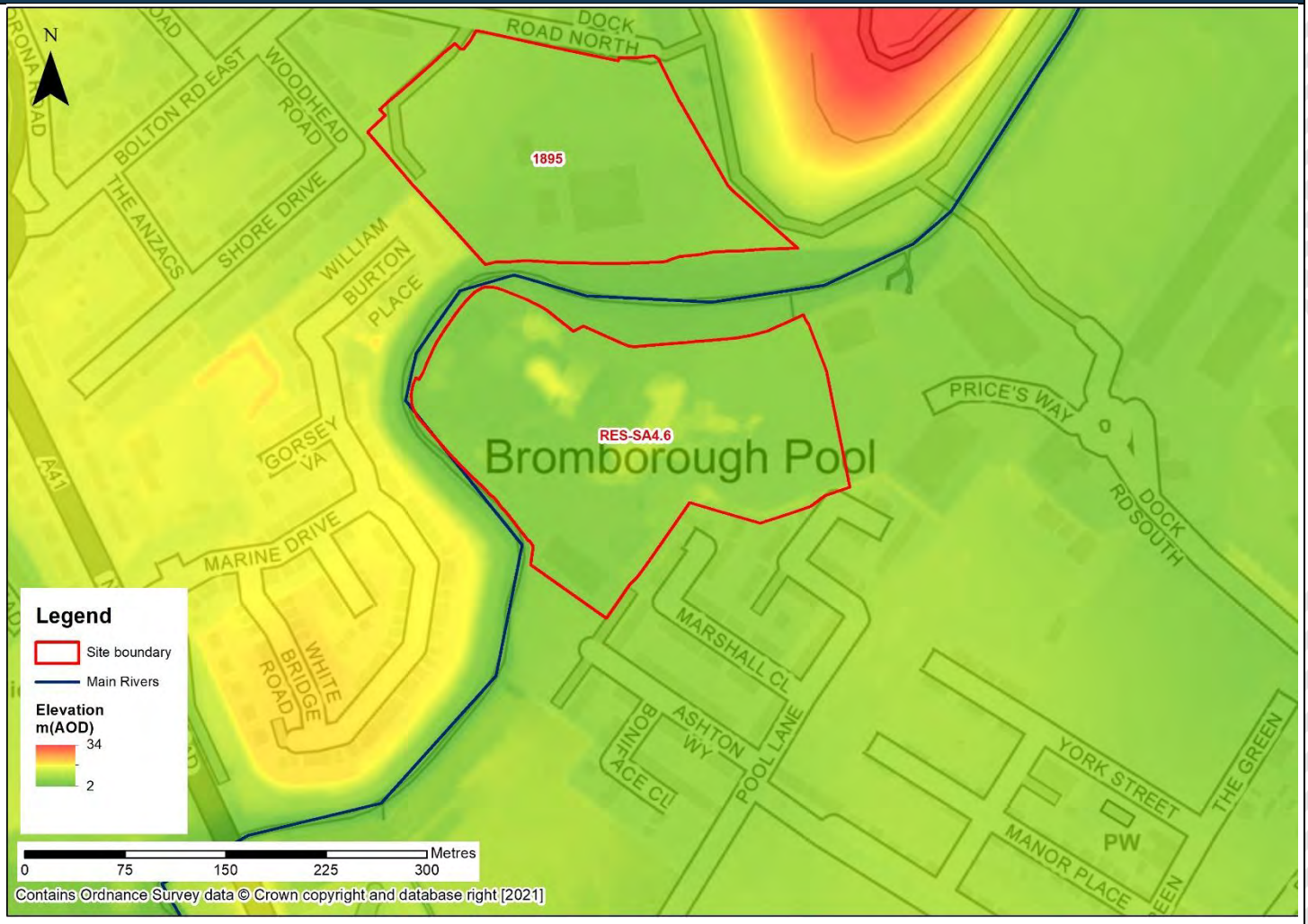


Figure 2: Topography

The elevation does not vary substantially across the site with a maximum elevation of approximately 14m AOD towards the centre of the site, and a minimum of approximately 6m AOD towards the edge of the site boundary.

Flood Source: Tidal

Flood Zones	Flood Zone 3b	Flood Zone 3b +climate change*	Flood Zone 3a	Flood Zone 3a +climate change*	Flood Zone 2
	1.9%	+97.6%	87.4%	+12.5%	9.5%
Tidal: maximum depth	N/A	1.9 m	0.08 m	2.4 m	N/A

All figures stated based on undefended model
*Climate change figures based on 70th percentile (higher central allowance)

RES-SA4.6, Former Croda, Bromborough Pool

Modelled tidal risk including climate change (Mersey Estuary 2018 model)

NOTE: modelled outputs for this SFRA are subtly different to original 2018 modelled outputs due to upgraded modelling and GIS software

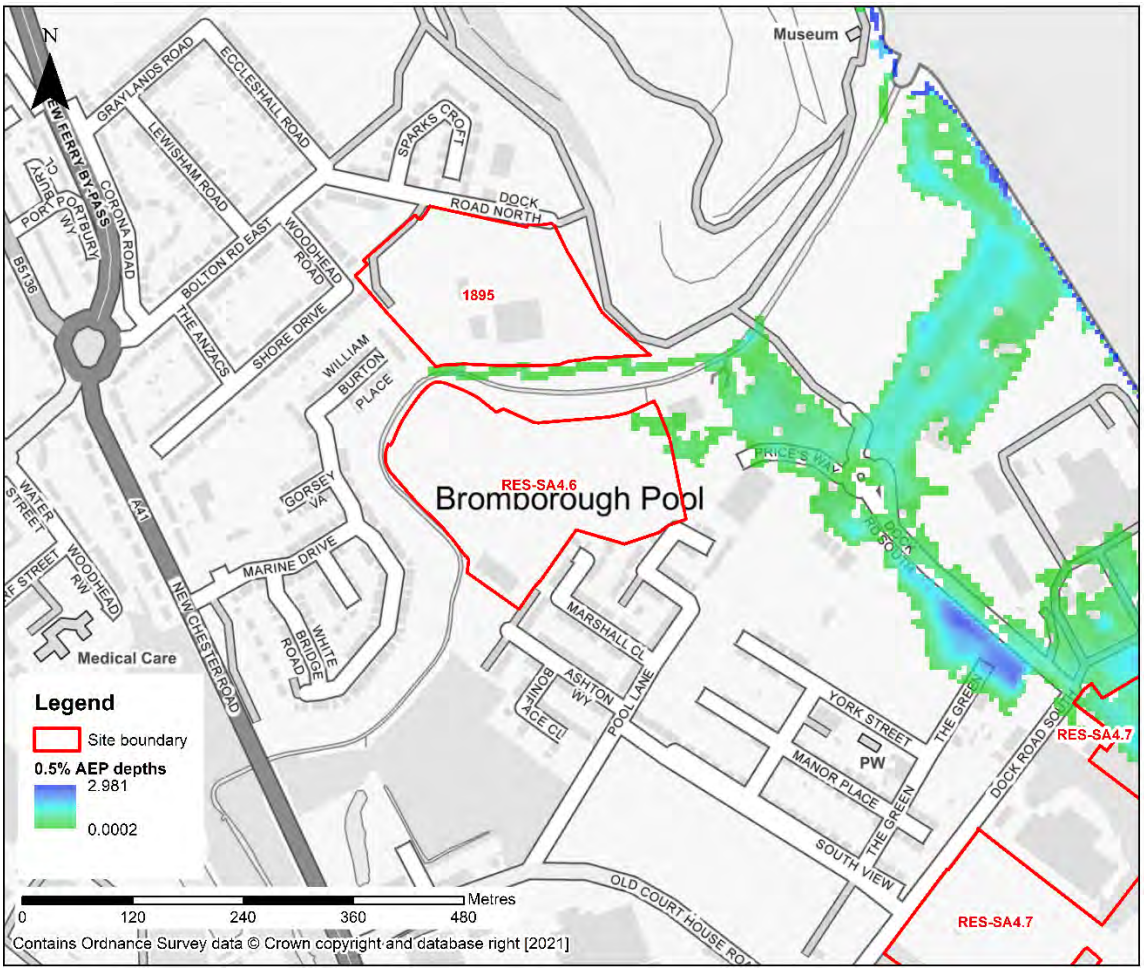


Figure 3: modelled tidal flood depths (m) for the 0.5% AEP baseline event

NOTE: the modelling outputs presented at this site are from the Mersey Estuary 2018 model only. The model for Dibbinsdale Brook is, at the time of writing, being updated and will not be finalised in time for this Level 2 SFRA. Therefore, the decision has been taken to use only the Mersey Estuary 2018 model to inform risk to the site at this stage. This explains why Flood Zone 3a, shown in Figure 1, is different to the 0.5% AEP event shown above in Figure 3. The majority of the present-day tidal risk to the site comes from Dibbinsdale Brook and therefore the Dibbinsdale Brook model. The risk shown in Figure 3 is therefore an underestimate.

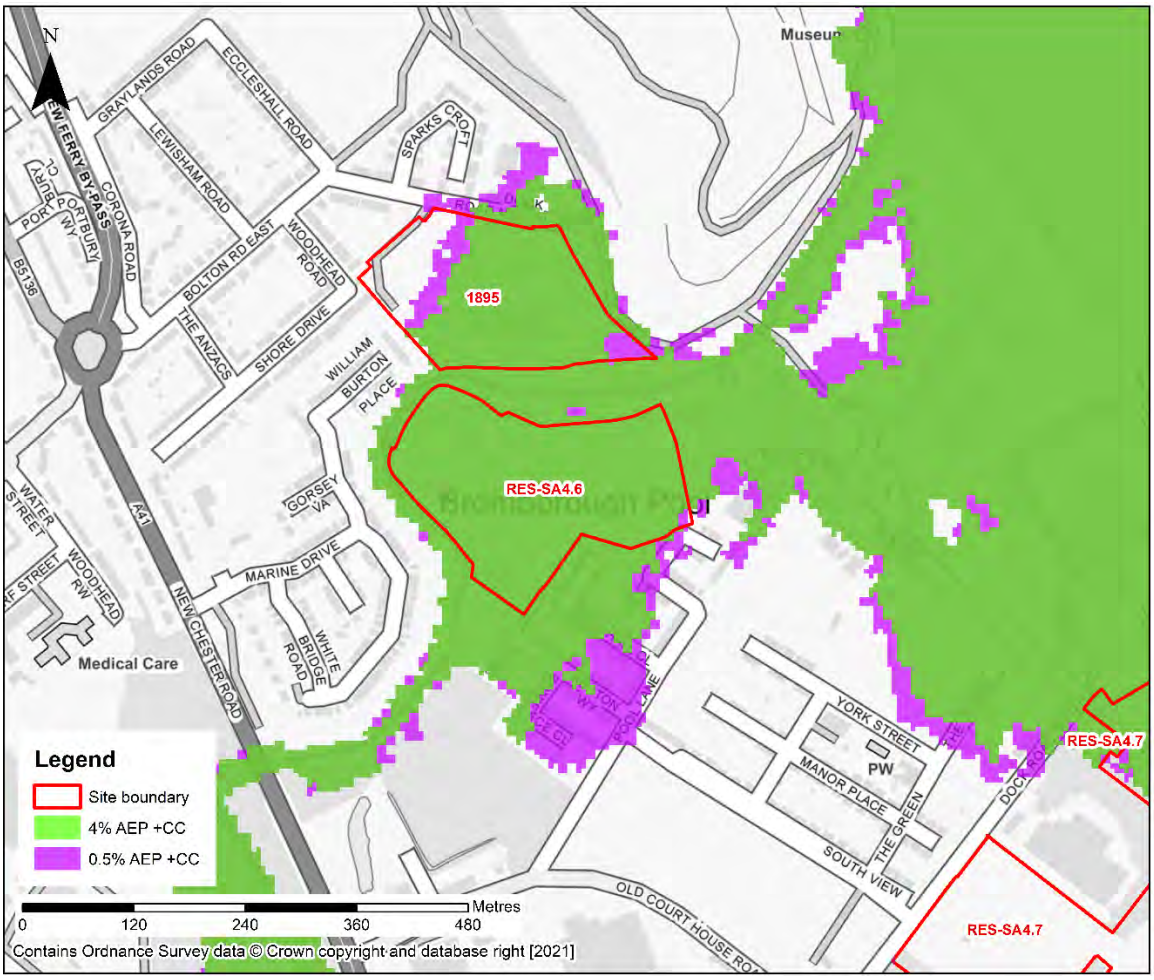


Figure 4: modelled tidal flood outlines for higher central climate change allowance

RES-SA4.6, Former Croda, Bromborough Pool

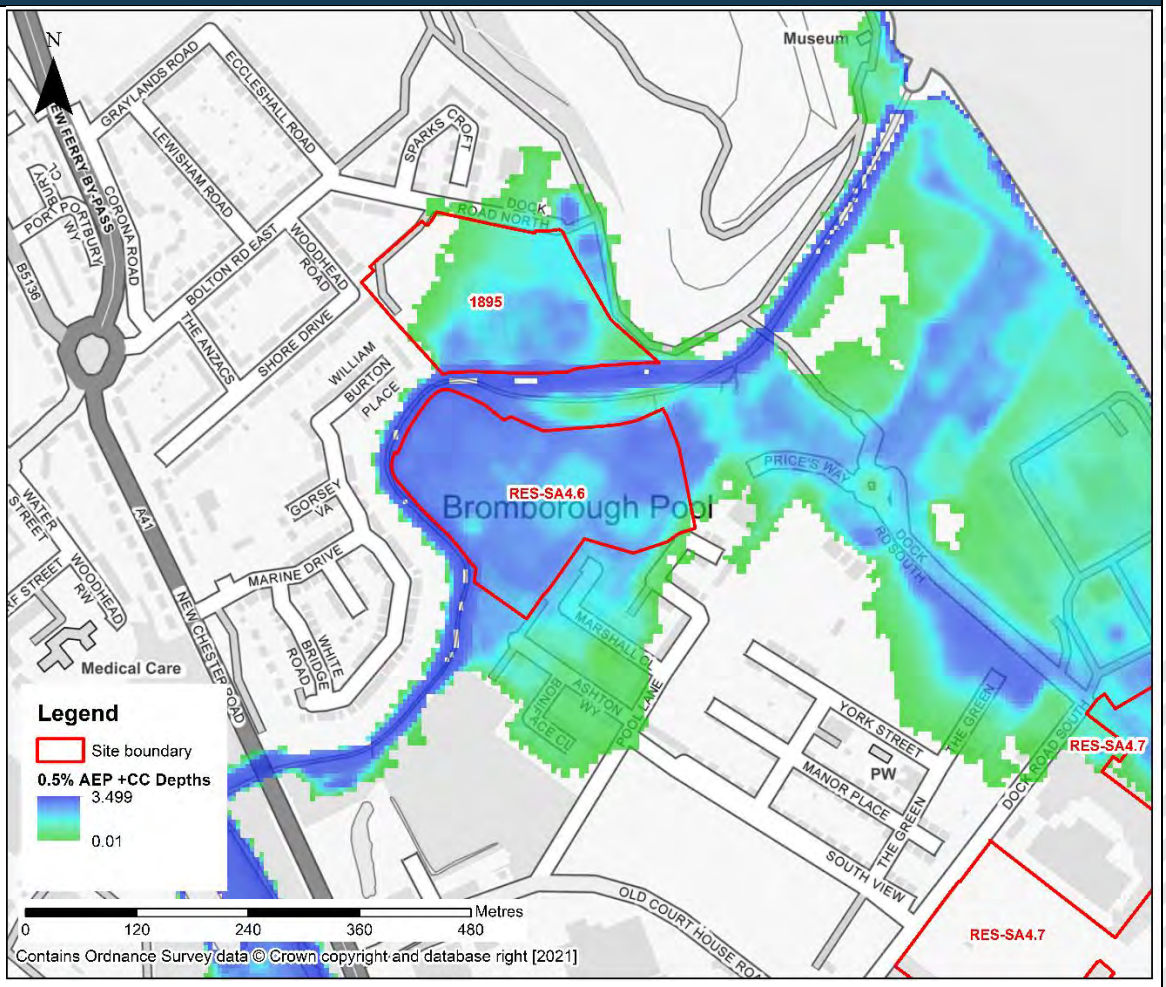
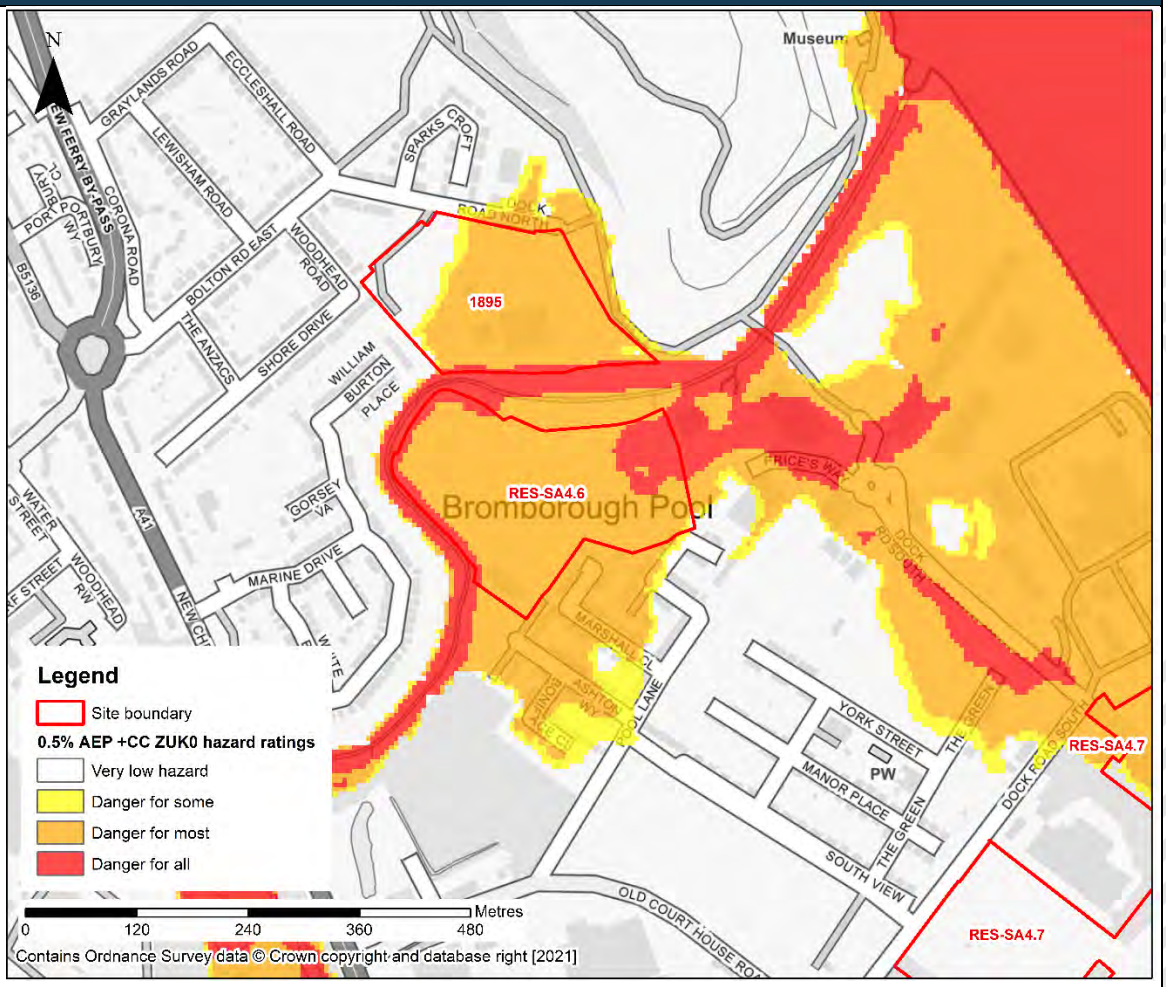


Figure 5: modelled tidal flood depths (m) for 0.5% AEP + climate change event

RES-SA4.6, Former Croda, Bromborough Pool	
	 **Figure 6: modelled tidal flood hazard for 0.5% AEP +climate change event** **Tidal hazard ratings based on Table 4 of the SUPPLEMENTARY NOTE ON FLOOD HAZARD RATINGS AND THRESHOLDS FOR DEVELOPMENT PLANNING AND CONTROL PURPOSE – Clarification of the Table 13.1 of FD2320/TR2 and Figure 3.2 of FD2321/TR1. May 2008.* Climate change will significantly impact the entire site in the long term. Depths reach up to 2.4 m in the west of the site and flood hazards range between 'danger for most to 'danger for all' for the 0.5% AEP event plus climate change. It is also evident from Figure 4 that the potential increase in functional floodplain due to climate change is significant with a further 98% of the site at risk from a 4% AEP tidal event plus climate change.
Historic flooding	There is no historic flooding known to have occurred at the site.
Defences	There is no known flood defence infrastructure in the vicinity of the site.
Flood Warning Area	According to the EA's FWA dataset, there is a tidal FWA (Irish Sea and Mersey Estuary from the Head of the Wirral to Runcorn) in operation across the site, with the exception of a small area in the southeast corner of the site.
Natural Flood Management /	According to the national scale 'potential for WwNP dataset', there is no potential for working with natural processes within the site. There are several areas just outside of

RES-SA4.6, Former Croda, Bromborough Pool	
Working with Natural Process	the site boundary where there is potential for floodplain reconnection.
Observations, mitigation options & site suitability: tidal	- The proposed development of the site would see a change in the risk classification from less vulnerable to more vulnerable, according to the NPPF. - Given the change in use and therefore vulnerability of the site, 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 change of use meets the objectives of the Framework'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) - Present day risk is tidal and primarily from Dibbinsdale Brook. However, the Dibbinsdale Brook model is not available for this SFRA. - The site boundary should be pulled back from Dibbinsdale Brook and out of the functional floodplain. - Given the present-day risk, the modelled risk from climate change and the difficulties with access and egress routes, it is recommended this site should not be developed for residential use. Ideally, this site would remain for less vulnerable uses with appropriate resilience measures put in place or be used as a multifunctional greenspace for flood storage, amenity use and to provide environmental/ecological benefits. - Land raising may be an option given the risk is tidal therefore compensatory storage would not be required. It is likely that any land raising would be required to be above the 0.5% AEP +climate change event maximum level of 2.4m plus an additional 600mm freeboard. Access and egress routes would also have to be raised and must lead to flood free areas. With the scale of land raising required this option is likely to be unfeasible. - Stilted development may be an option though is likely to be an expensive design solution with access and egress routes also required to be above the design flood level. - A further option may be for ground floor parking or other less vulnerable uses (i.e. non-residential such as shops, restaurants, offices) and for habitable dwellings to be situated on first floor and upwards. However, safe access and egress routes must be available at times of flood, even for above ground floor accommodation. - Safe access and egress routes must be available at times of flood and appear to be available from the east via Ashton Way, Marshall Close and Price's Way. These are located within Flood Zone 2, however a FWA is in place which should provide advanced warning for site users to evacuate ahead of a flood event. - A flood risk activity permit may be required as the development is within 8m of Dibbinsdale Brook. Details on obtaining a Flood Risk Activity Permit are available from the EA. The EA would also recommend no development within 8m of any watercourse to allow for access for maintenance purposes.
Flood source: infrastructure failure – reservoirs (residual)	
Flood risk: reservoir	There is no risk of flooding to the site as a result of dam failure, according to the EA's online RFM.
Flood source: infrastructure failure – canals (residual)	
Flood risk: canal	There are no canals in the vicinity of this site.

RES-SA4.6, Former Croda, Bromborough Pool			
Flood source: surface water			
Surface Water Flood Risk to Proposed Development Site			
Current site: Risk of Flooding from Surface Water map	High Risk (3.3% AEP event)	Medium Risk (1% AEP event)	Low Risk (0.1% AEP event)
	0.6%	2.9%	13.2%
Surface water max flood depths	0.15 – 0.3m	>1.2m	>1.2m

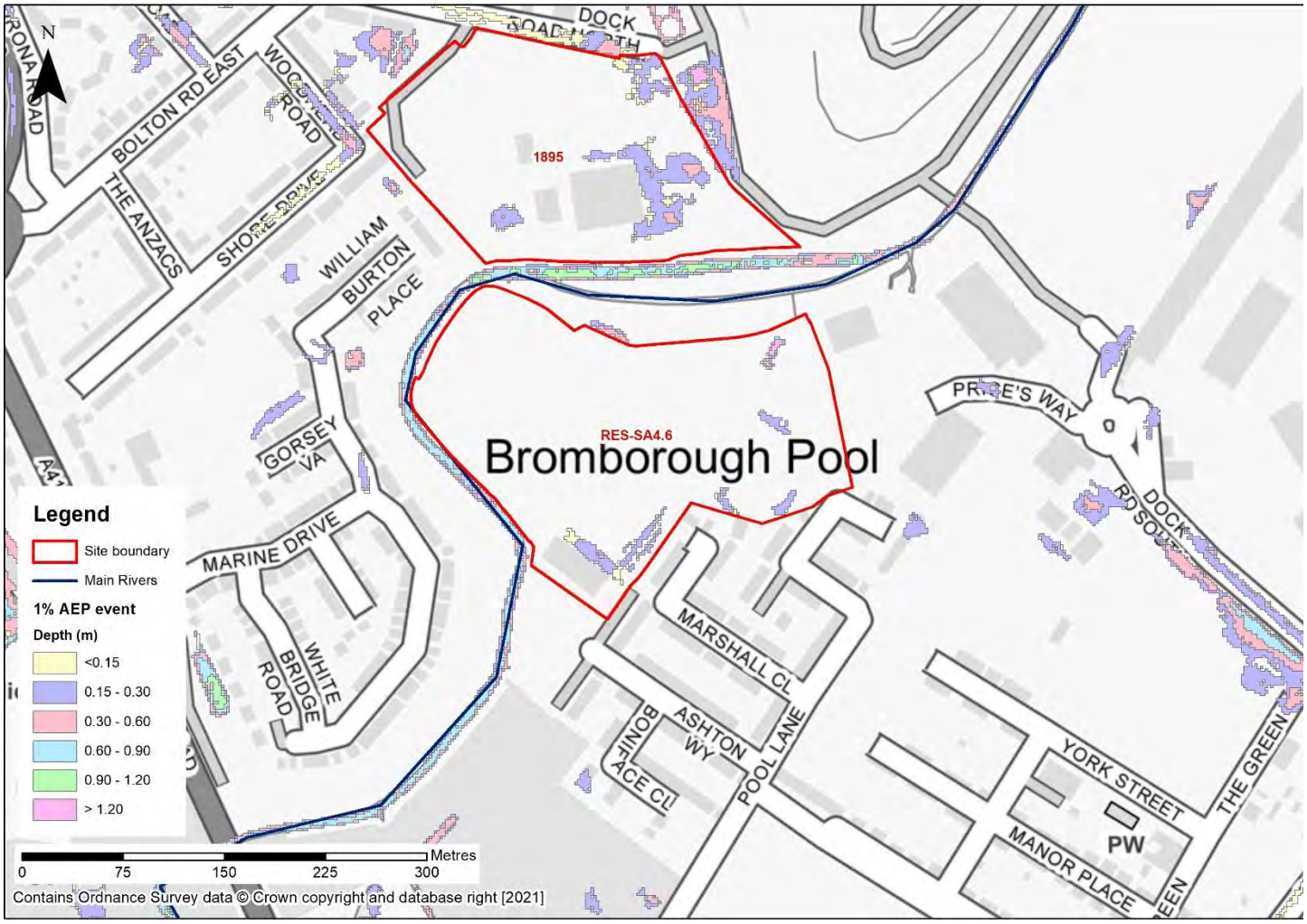


Figure 7: 1% AEP event surface water flood depths (Risk of Flooding from Surface Water map)

RES-SA4.6, Former Croda, Bromborough Pool

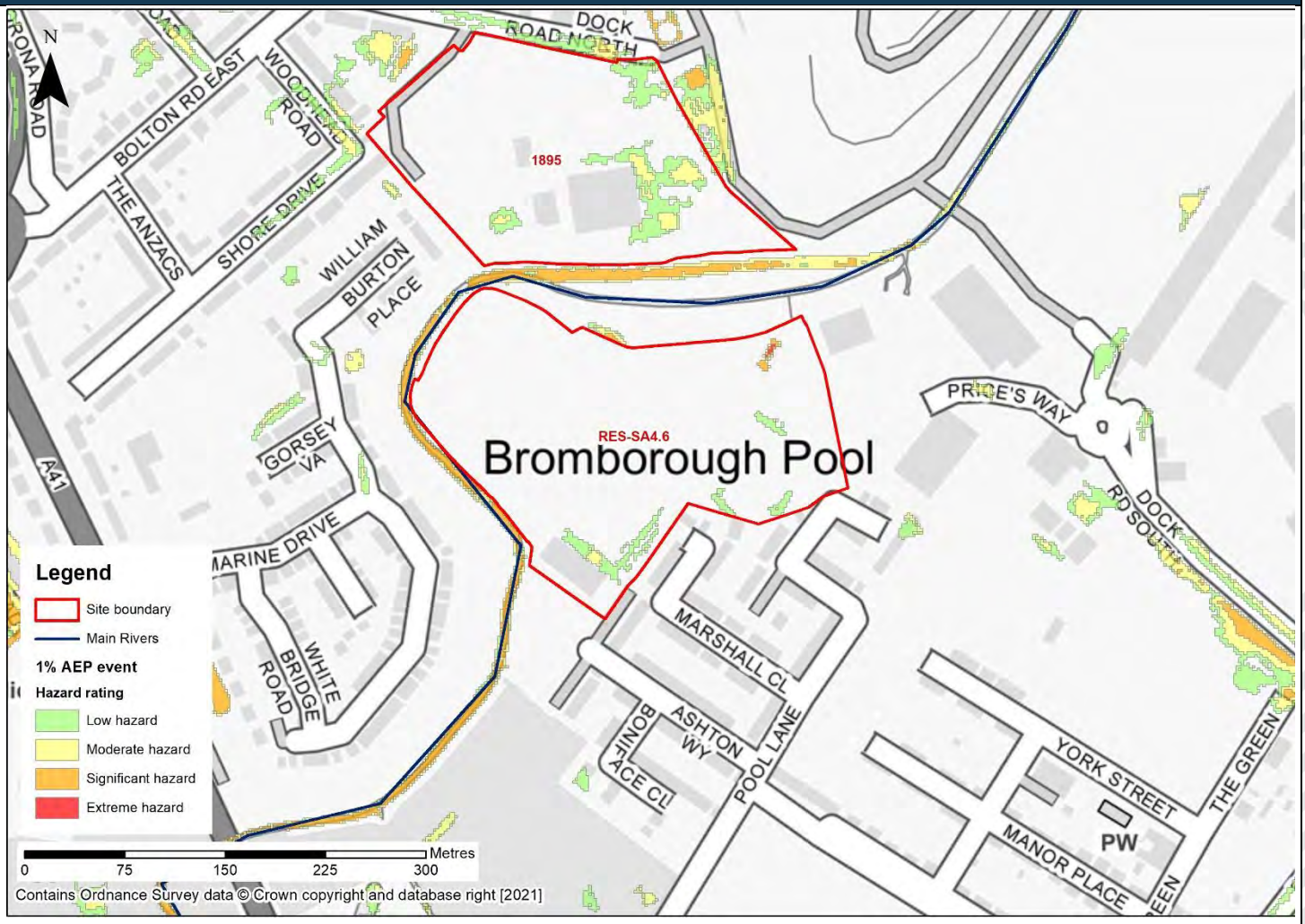
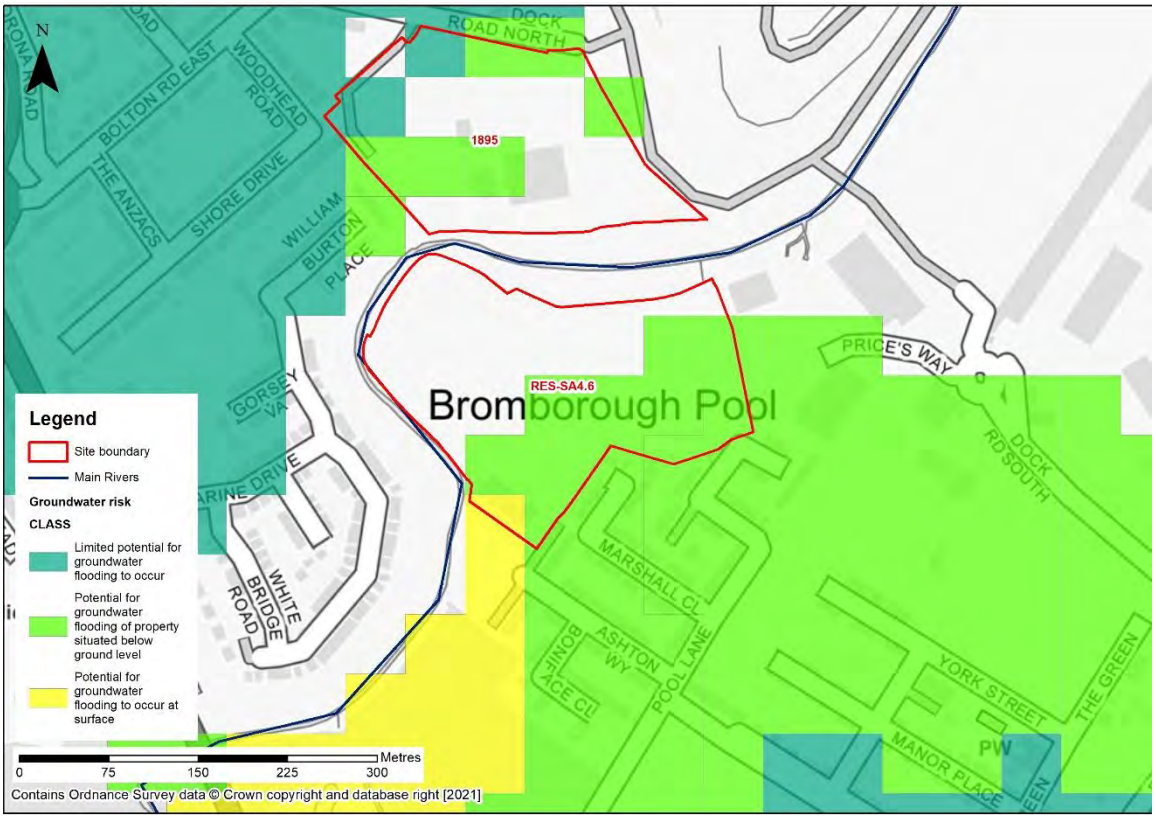


Figure 8: 1% AEP event surface water flood hazards (Risk of Flooding from Surface Water map)

**Surface water hazard rating based on Table 4.2 Hazard to People as a Function of Velocity and Depth, R&D OUTPUTS: FLOOD RISKS TO PEOPLE: PHASE 2 FD2321/TR2. Defra. March 2006.*

Surface water flood risk to development site	Surface water risk is nominal. Access from the south appears achievable
Climate change	The current day 0.1% AEP event outline provides an indication of the likely increase in extent of the more frequent events. The 0.1% AEP event outline covers approximately 13% of the total site area and the extent is localised to the southern and eastern borders. Marshall Close to the south becomes partially inundated during a 0.1% AEP surface water flood event, but as depths range between 0.15 and 0.30 m, safe access and egress via this road should remain viable.
Observations, mitigation options & site suitability: surface water	- Given the size of the site, a full drainage strategy would be required to ensure there is no increase in surface water flood risk elsewhere as a result of new development. This will require surface water modelling based on proposed layout plans. Consultation with the LLFA should be carried out on surface water drainage arrangements. - Safe access and egress routes from the south should be achievable.

RES-SA4.6, Former Croda, Bromborough Pool						
Surface Water Flood Risk from Proposed Development						
Runoff rates should not exceed current rates and if possible, betterment of existing rates should be aimed for. For the purposes of this assessment, the required volumes of attenuation have been calculated below based on an assumed 85% impermeable area and limiting greenfield runoff rate of Qbar (l/s).						
Proposed development limiting runoff rate: (l/sec) Qbar: 26.86 l/s (FEH Statistical) Q30: 45.65 l/s Q100: 55.86 l/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
30yr Rainfall+20%	7.75	2414	525	1890	27.8	0.126 ha 2.716 %
30yr Rainfall+40%	9	2908	609	2298	33.9	0.153 ha 3.302 %
100yr Rainfall+20%	9.25	3362	626	2736 (846 exceedance storage)	40.3	0.182 ha 3.931 %
100yr Rainfall+40%	10.5	4014	711	3303 (1005 exceedance storage)	48.7	0.220 ha 4.746 %
Climate change	Application of the central (+20%) and upper end (+40%) allowances for potential change anticipated for the 2080s in the table above shows the estimated attenuation volumes for the 1% AEP and 3.33% AEP rainfall events.					
Surface water: flood risk impacts from development site, mitigation & SuDS	- As part of this Level 2 SFRA we have included calculations to provide an estimated land take if a pond with an assumed depth of 1.5m was included as part of the development. - Attenuation volumes are presented for the critical storm duration for the 3.33% AEP event with exceedance flows quantified up to the 1% event. To prevent development worsening flood risk elsewhere, surface water runoff must be managed on site. - To prevent development worsening flood risk elsewhere, surface water runoff must be managed on site.					

RES-SA4.6, Former Croda, Bromborough Pool	
Flood Source: Groundwater	
Flood risk: groundwater	 **Figure 9: Susceptibility of groundwater flooding (BGS national dataset)** Based on geological and hydrogeological information, the BGS dataset can be used to identify areas where geological conditions could enable groundwater flooding to occur and where groundwater may come close to the ground surface. The dataset should not be used on its own to make planning decisions at any scale and should not be used to inform planning decisions at the site scale. The susceptibility data cannot be used on its own to indicate risk of groundwater flooding. The dataset shows that there is potential for groundwater flooding of property situated below ground level across the south and eastern extent of the site, with a small area of potential for groundwater flooding to occur at the surface. Any development plans should therefore further investigate ground conditions before planning the construction of any basements or below ground car parking.
Overall Site Assessment	
Access and egress	Based on the tidal risk presented from the Mersey Estuary 2018 model, safe access and egress routes may be challenging to achieve when accounting for climate change. However, a FWA is in place which should provide advanced warning for site users to evacuate ahead of a flood event.
Recommendation summary	Based on the evidence presented in the Level 1 SFRA and this Level 2 SFRA: - Early discussions should take place with the EA with regards to the tidal flood risk issues on this site. The EA offers early engagement through an advisory service via their website (https://www.gov.uk/guidance/developers-get-environmental-advice-on-your-planning-proposals) or by emailing the local office: SPPlanning.RFH@environment-agency.gov.uk.

RES-SA4.6, Former Croda, Bromborough Pool	
	- This site should not be developed for residential use given the significant long-term risk with climate change. The site should remain for less vulnerable uses with resilience measures in place or alternatively left as open space and converted to multifunctional amenity greenspace providing flood storage and social and environmental benefits. - No development within 8 m of the EA Main River Dibbinsdale Brook. - Given that there is potential for groundwater flooding to property below ground level across the south and eastern extent of the site, it is recommended that no subsurface development is permitted. - This assessment could be revisited once the Dibbinsdale Brook model has been updated. However, it is likely that risk will be further exacerbated by risk from Dibbinsdale Brook. - Any consideration for development must fully investigate the options presented in this Level 2 SFRA, including for the provision of safe access and egress routes.
Can the second part of the Exception Test be satisfied?	No. To pass the Exception Test, it must be proven that the site can be safe for its lifetime, which for residential development is 100 years. The climate change modelling in this Level 2 SFRA shows this will not be possible, as the site is modelled to be inundated during a 0.5% + climate change event.
FRA requirements	- For development to proceed, the FRA must show the development can be safe for its lifetime and must not increase risk elsewhere. - The FRA should assess the options for onsite land raising and other mitigation measures. - The FRA should include a drainage strategy for the proposed new development layout. - The FRA should include emergency planning procedures with consideration to ensuring safe access and egress routes in times of flood. - Any FRA should be carried out in line with the NPPF; FRCC-PPG; Local Plan and LLFA policies; and national and local SuDS policy and guidelines. - Throughout the FRA process, consultation should be carried out with the following, where applicable, the LPA; LLFA; emergency planning officers; EA; UU; the highways authorities; and the emergency services.

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Wirral Level 2 Strategic Flood Risk Assessment

Site RES-SA4.7

Final Report

April 2022

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Revision History

Revision Ref / Date	Amendments	Issued to
V1.0 Draft September 2021	-	John Entwistle
V1.0 Final February 2022		John Entwistle
V3.0 Final April 2022	Site boundary amended	John Entwistle

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Analyst

Reviewed by ..... Mike Williamson BSc MSc CGeog FRGS EADA

Principal Flood Risk Analyst

Purpose

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Abbreviations

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LPA	Local Planning Authority
NPPF	National Planning Policy Framework
RFM	Reservoir Flood Map
RoFSW	Risk of Flooding from Surface Water
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Drainage Systems
UU	United Utilities
WFD	Water Framework Directive

RES-SA4.7 – SHLAA 4021 Land Off Dock Road South, Bromborough	
Location	Bromborough
Site area (ha)	22.7
Watercourse	Mersey Estuary
EA Model used	Mersey Estuary 2018 Model
Existing use	Brownfield
Existing site flood risk vulnerability classification (NPPF)	Less vulnerable
Proposed use	Residential
Proposed development flood risk vulnerability classification (NPPF)	More vulnerable
Proposed development impermeable area (ha)	19.3
Note: there has been a minor amendment to the north western and south eastern boundaries of this site since this Level 2 SFRA was produced, however flood risk to the site and subsequent recommendations have not changed.	

RES-SA4.7 – SHLAA 4021 Land Off Dock Road South, Bromborough

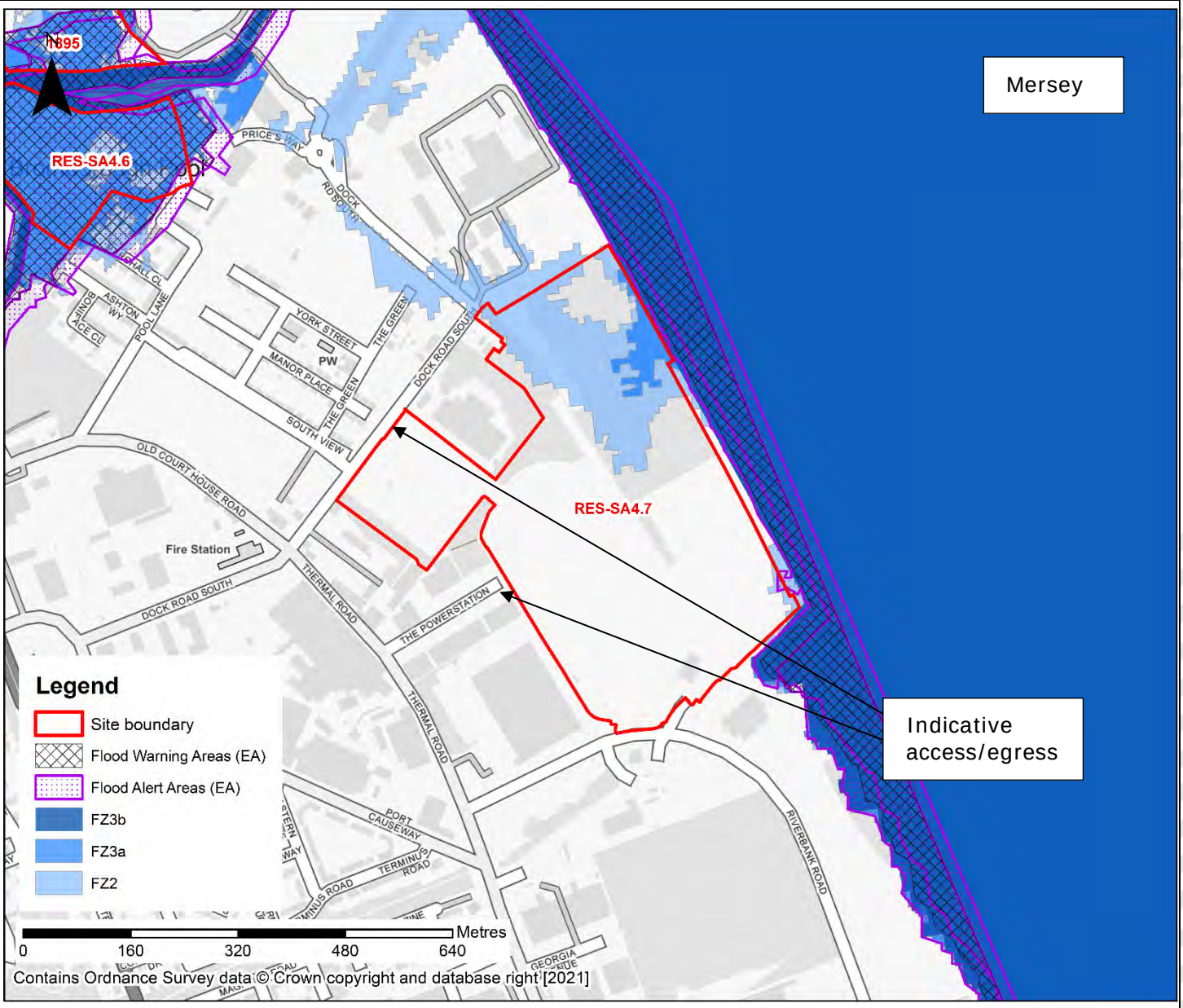


Figure 1: Existing tidal flood zones and flood risk data

The site lies adjacent to the Mersey Estuary. The majority of the site is situated within Flood Zone 1, with the exception of the northern extent in tidal Flood Zone 2 (with a small proportion falling within tidal Flood Zone 3). The site itself is not within a Flood Warning Area or Flood Alert Area, but these areas are adjacent to the eastern boundary of the site. There is no historic flooding mapped within the vicinity of the site.

RES-SA4.7 – SHLAA 4021 Land Off Dock Road South, Bromborough

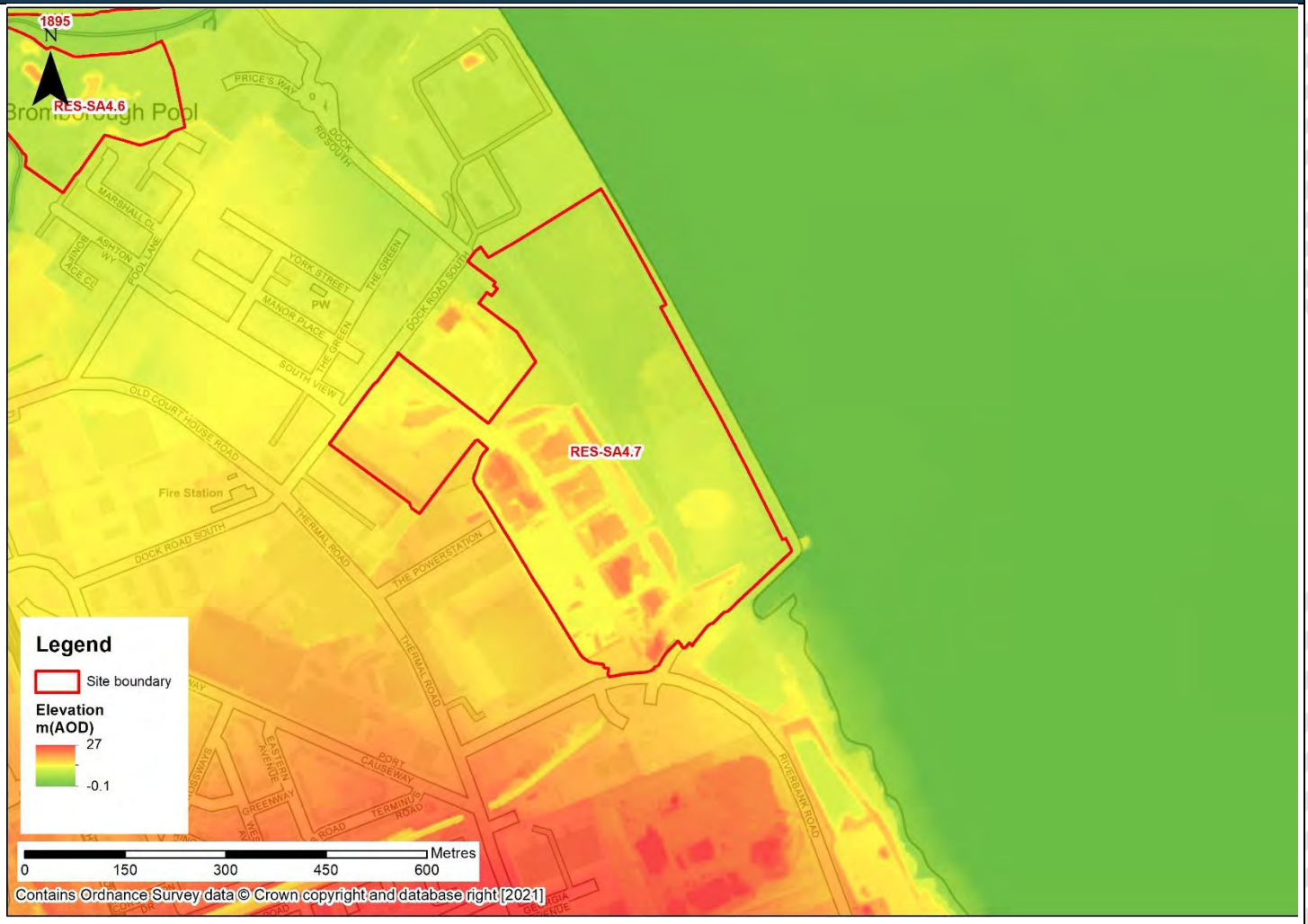


Figure 2: Topography

The elevation varies across the site. The topography at the north and east is relatively flat with elevation ranging from approximately 7m to 10m AOD. Towards the west and south of the site there are multiple raised mounds with crests ranging between approximately 13m and 17m AOD. There are tracks in-between the mounds at a lower elevation (approximately 10m AOD).

Flood Source: Tidal

Flood Zones	Flood Zone 3b	Flood Zone 3b +climate change*	Flood Zone 3a	Flood Zone 3a +climate change*	Flood Zone 2
	0%	+29.7%	2.6%	+37.6%	16.0%
Tidal: maximum depth	N/A	1.0 m	0.5 m	1.5 m	N/A

All figures stated based on undefended model

*Climate change figures based on 70th percentile (higher central allowance)

RES-SA4.7 – SHLAA 4021 Land Off Dock Road South, Bromborough

Modelled tidal risk including climate change for the Mersey Estuary (Mersey Estuary 2018 model)

NOTE: modelled outputs for this SFRA are subtly different to original 2018 modelled outputs due to upgraded modelling and GIS software

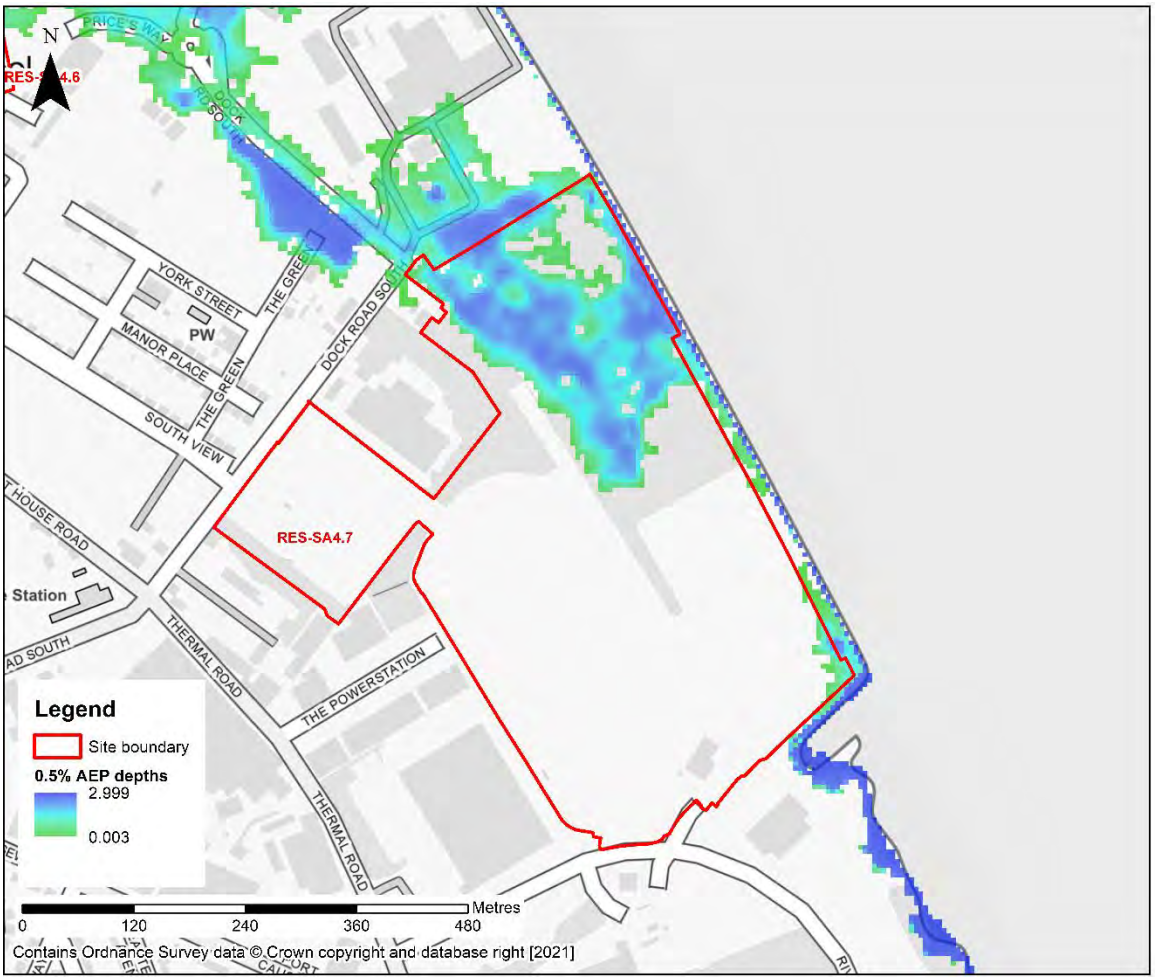


Figure 3: modelled tidal flood depths (m) for 0.5% AEP baseline event

Note: Modelled baseline flood extents for the 0.5% AEP event vary slightly from the existing Flood Zone 3a outlines. This is a result of the existing flood zones using the old Coastal Flood Boundaries (CFB) from 2011 and the model having a base year of 2015. The previous CFB excluded data from the Class A gauge at Liverpool due to differences with the surrounding gauges at Heysham and Hilbre Island. The new CFB in 2018 included gauge data from Liverpool and an uplift was added to get the model to a base year of 2021, meaning the levels at the mouth of the estuary increased by over 0.3m causing additional flooding to certain areas.

The current Flood Map for Planning therefore will underestimate present day tidal flood risk to the Wirral. The tidal models should be updated with the new CFB data.

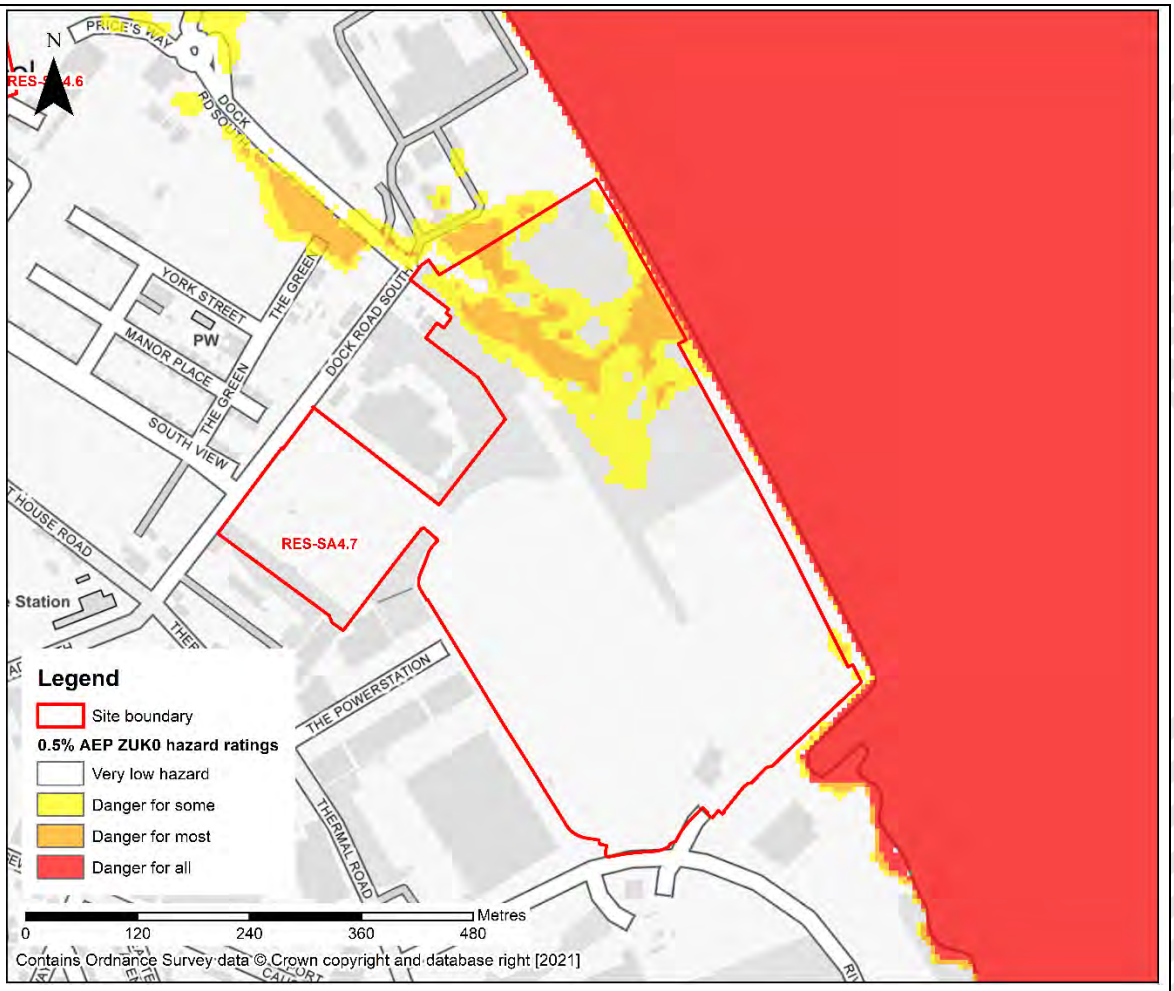


Figure 4: modelled tidal flood hazards for 0.5% baseline event

RES-SA4.7 – SHLAA 4021 Land Off Dock Road South, Bromborough

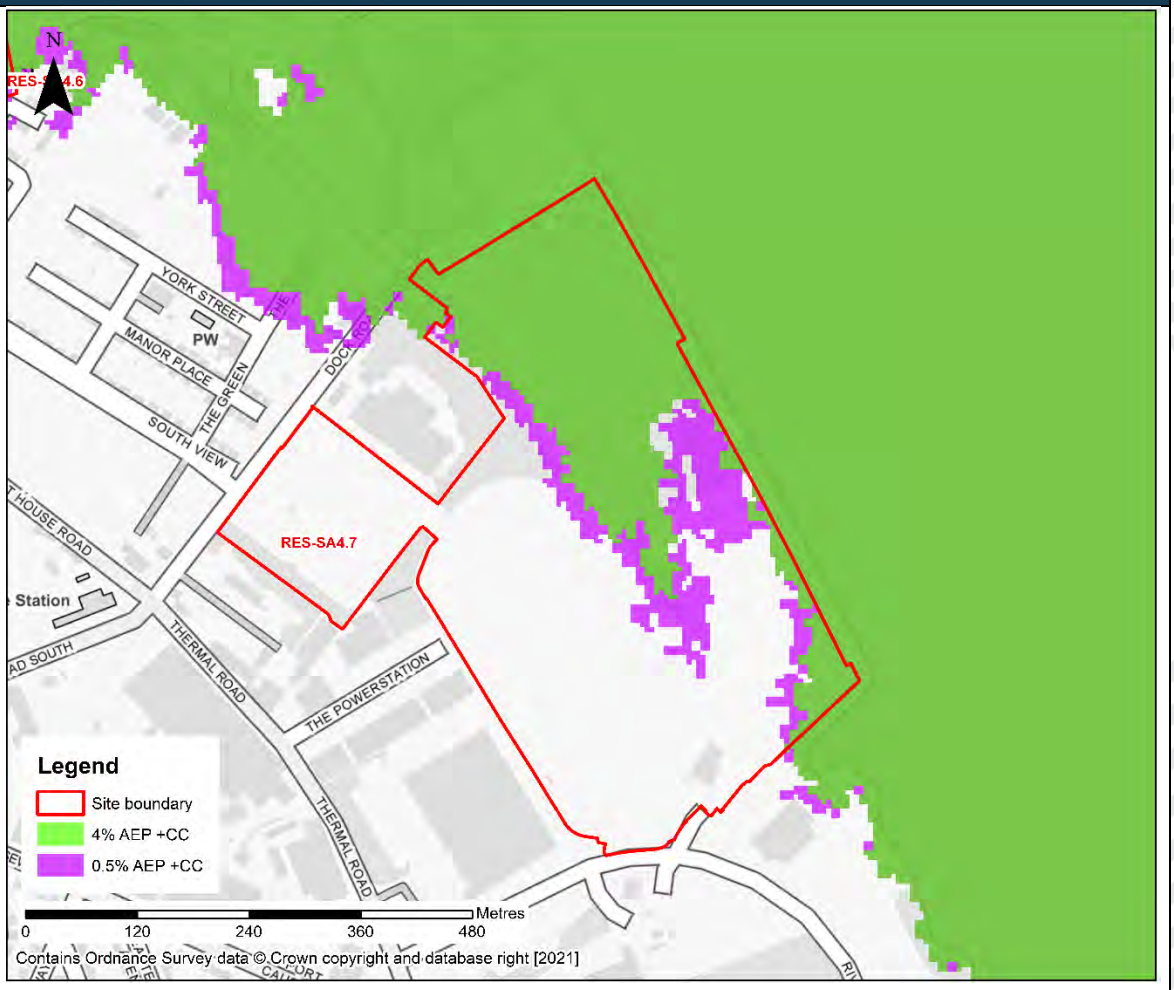


Figure 5: modelled flood outlines for higher central climate change allowance

RES-SA4.7 – SHLAA 4021 Land Off Dock Road South, Bromborough

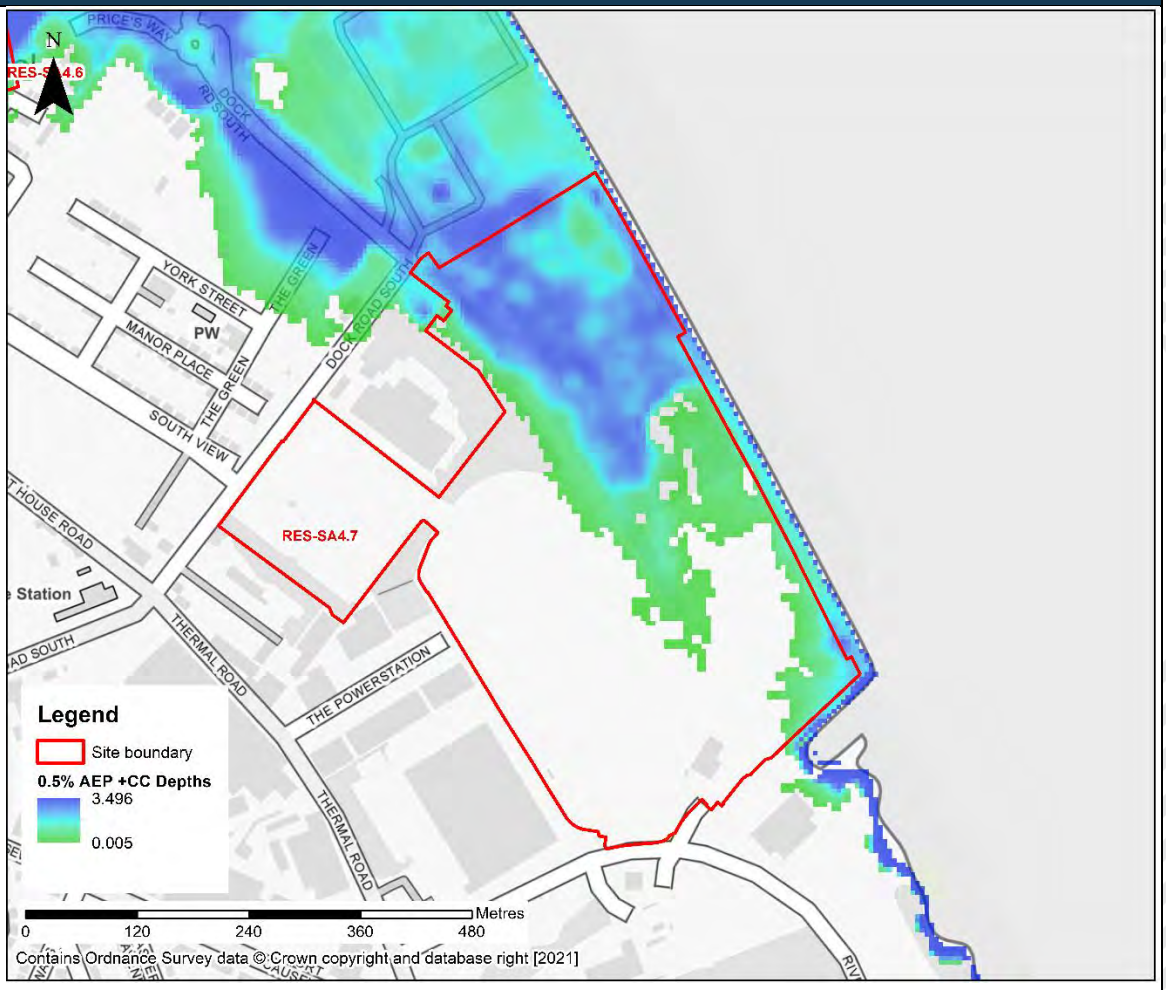
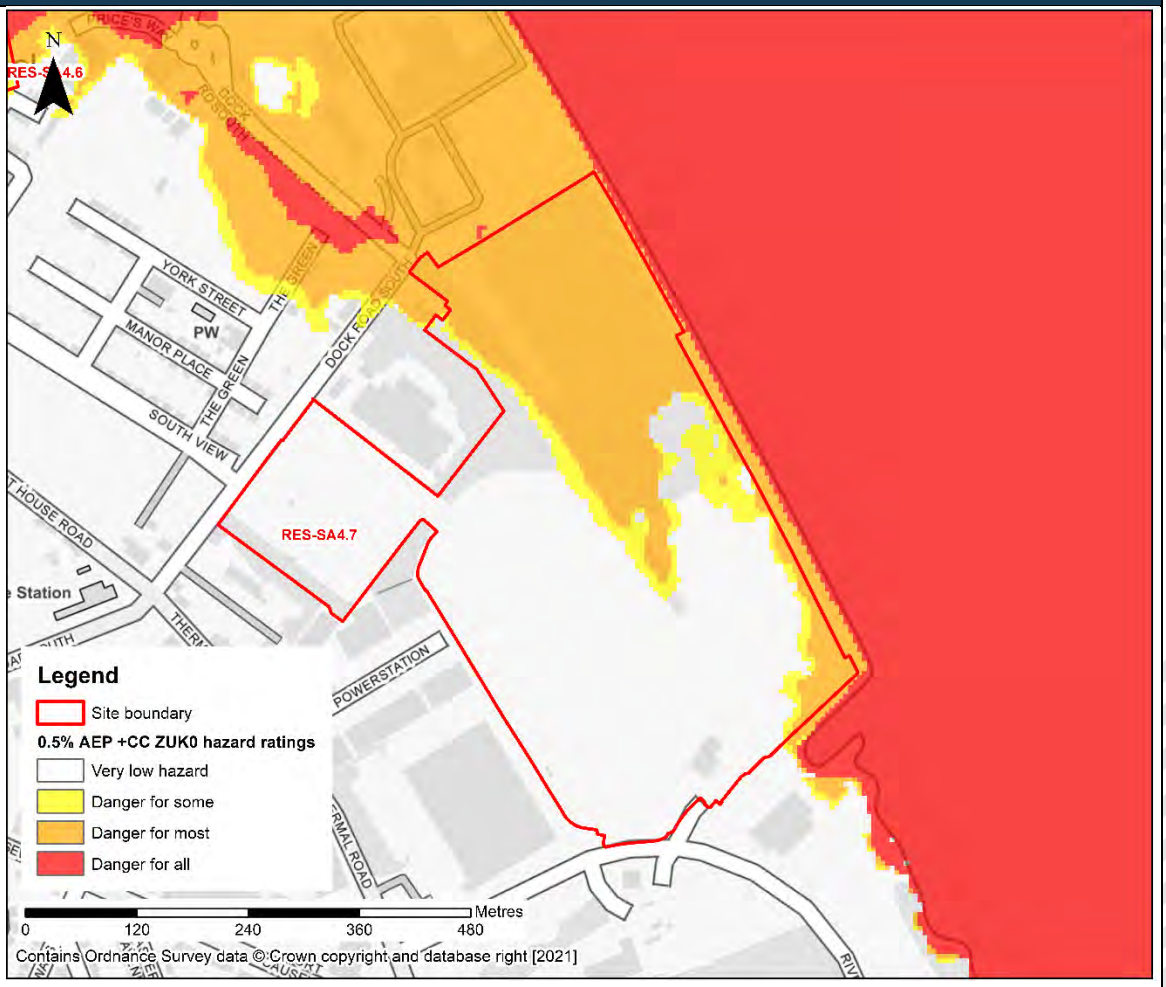


Figure 6: modelled flood depths (m) for 0.5% AEP + climate change event

RES-SA4.7 – SHLAA 4021 Land Off Dock Road South, Bromborough	
	 **Figure 7: modelled flood hazard for 0.5% AEP +climate change event** **Tidal hazard ratings based on Table 4 of the SUPPLEMENTARY NOTE ON FLOOD HAZARD RATINGS AND THRESHOLDS FOR DEVELOPMENT PLANNING AND CONTROL PURPOSE – Clarification of the Table 13.1 of FD2320/TR2 and Figure 3.2 of FD2321/TR1. May 2008.* Climate change will impact the north and east of the site in the long term. Depths reach a maximum of 1.5 m and flood hazards range between 'danger for some' to 'danger for most'. The risk is however isolated to one area of the site.
Historic flooding	There is no known historic flooding mapped in the vicinity of the site.
Defences	There is no known flood defence infrastructure in the vicinity of the site.
Flood Warning Area	According to the EA's FWA dataset, there is no FWA in operation within the site, but there is an FWA (Irish Sea and Mersey Estuary from the Head of the Wirral to Runcorn) to the east of the site boundary.
Natural Flood Management / Working with Natural Process	According to the national scale 'potential for WwNP dataset', there is no potential for natural flood management at the site.

RES-SA4.7 – SHLAA 4021 Land Off Dock Road South, Bromborough	
Observations, mitigation options & site suitability: tidal	- The proposed use of the site would see a change in the risk classification from less vulnerable to more vulnerable, according to the NPPF. - Given the change in use and therefore vulnerability of the site, 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 change of use meets the objectives of the Framework'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). - The majority of this site is suitable for development. Development should be directed to Flood Zone 1 and the area outside of the climate change risk area shown in Figures 6 and 7. The modelling also shows the potential expansion of the functional floodplain across the site by way of the 4% AEP +climate change event outline in Figure 5. - Ideally, the area at risk from climate change should be left as open space and used as multifunctional greenspace for flood storage, amenity use and to provide environmental/ecological benefits. - However, given the risk is tidal and the site borders the Mersey Estuary, land raising may be possible in this area without the need for compensatory storage. It is likely that any land raising would be required to be above the 0.5% AEP +climate change event maximum level of 1.5m plus an additional 600mm freeboard. Access and egress routes would also have to be raised in this area and must lead to flood free areas. - Safe access and egress routes appear to be available from the southeast of the site via Riverbank Road. - The EA recommend for an 8m no development buffer alongside any watercourse to allow for maintenance access. Also, a flood risk activity permit may be required as the site is within 16 metres of the tidally influence Mersey Estuary. Details on obtaining a Flood Risk Activity Permit are available from the EA.
Flood source: infrastructure failure – reservoirs (residual)	
Flood risk: reservoir	There is no risk of flooding to the site as a result of dam failure, according to the EA's online RFM.
Flood source: infrastructure failure – canals (residual)	
Flood risk: canal	There are no canals in the vicinity of this site.

RES-SA4.7 – SHLAA 4021 Land Off Dock Road South, Bromborough			
Flood source: surface water			
Surface Water Flood Risk to Proposed Development Site			
Current site: Risk of Flooding from Surface Water map	High Risk (3.3% AEP event)	Medium Risk (1% AEP event)	Low Risk (0.1% AEP event)
	0.5%	2.5%	11.3%
Surface water max flood depths	0.3 – 0.6 m	0.3 – 0.6 m	0.6 – 0.9 m

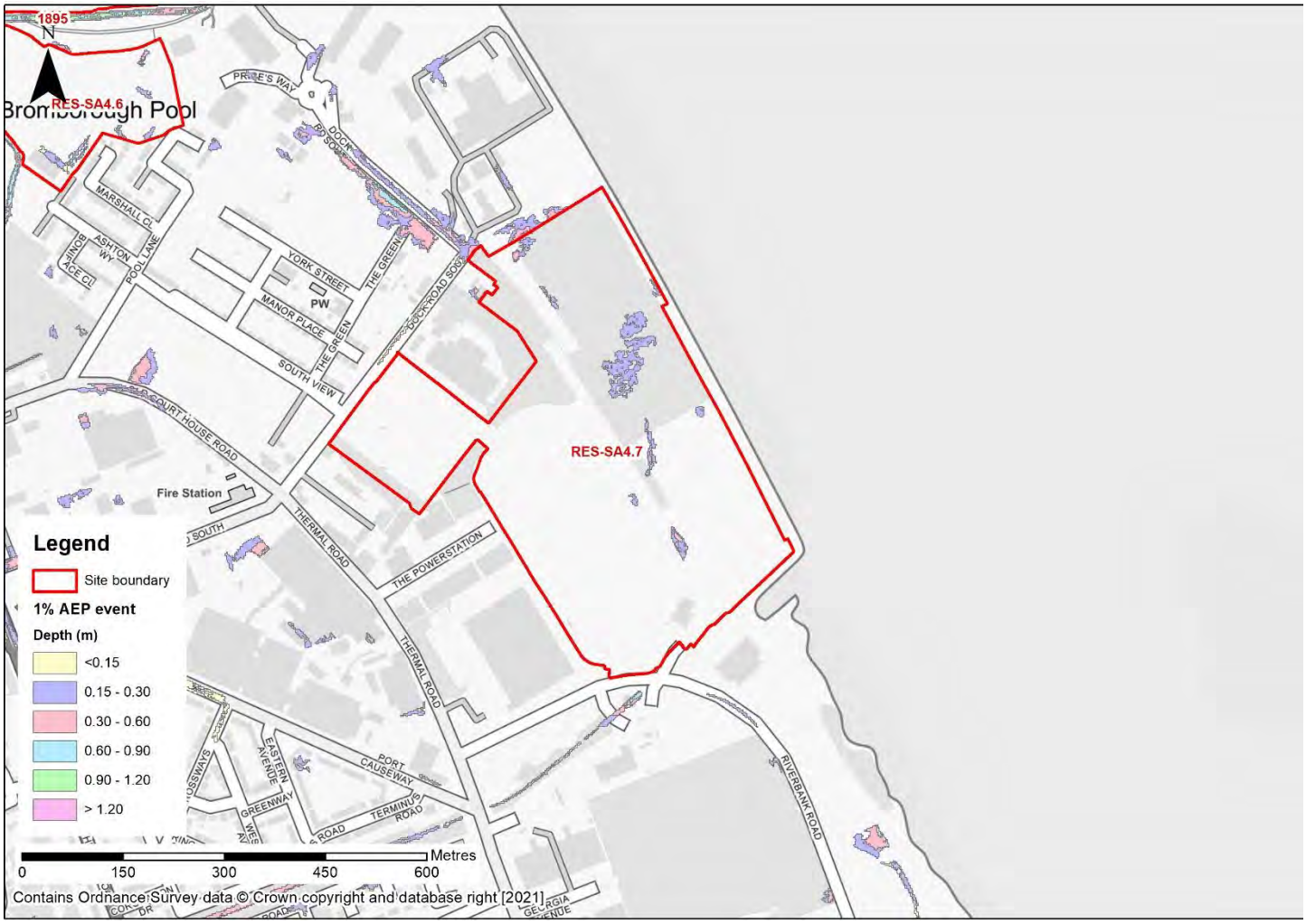


Figure 8: 1% AEP event surface water flood depths (Risk of Flooding from Surface Water map)

RES-SA4.7 – SHLAA 4021 Land Off Dock Road South, Bromborough

Figure 9: 1% AEP event surface water flood hazards (Risk of Flooding from Surface Water map)

**Surface water hazard rating based on Table 4.2 Hazard to People as a Function of Velocity and Depth, R&D OUTPUTS: FLOOD RISKS TO PEOPLE: PHASE 2 FD2321/TR2. Defra. March 2006.*

Surface water flood risk to development site	Nominal risk primarily localised to small areas in the centre of the site. Safe access and egress achievable at multiple locations around the site.
Climate change	The current day 0.1% AEP event outline provides an indication of the likely increase in extent of the more frequent events. The 0.1% AEP event outline covers approximately 11% of the total site area and the extent is localised to the north and east of the site where the tidal risk is concentrated. Safe access and egress should remain viable via The Power Station road or Dock Road South.
Observations, mitigation options & site suitability: surface water	- Given the large size of the site, a detailed drainage strategy would be required to ensure there is no increase in surface water flood risk elsewhere as a result of new development. This will require surface water modelling based on proposed layout plans and consultation with the LLFA.

RES-SA4.7 – SHLAA 4021 Land Off Dock Road South, Bromborough						
Surface Water Flood Risk from Proposed Development						
Runoff rates should not exceed current rates and if possible, betterment of existing rates should be aimed for. For the purposes of this assessment, the required volumes of attenuation have been calculated below based on an assumed 85% impermeable area and limiting greenfield runoff rate of Qbar (l/s).						
Proposed development limiting runoff rate: (l/sec) Qbar: 129.61 l/s (FEH Statistical) Q30: 220.33 l/s Q100: 269.58 l/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
30yr Rainfall+20%	8	11884	2613	9271	28.3	0.618 ha 2.724 %
30yr Rainfall+40%	9.25	14303	3021	11282	34.4	0.752 ha 3.315 %
100yr Rainfall+20%	9.25	16471	3021	13450 (4179 exceedance storage)	41.1	0.897 ha 3.952 %
100yr Rainfall+40%	10.75	19746	3511	16235 (4953 exceedance storage)	49.6	1.082 ha 4.770 %
Climate change	Application of the central (+20%) and upper end (+40%) allowances for potential change anticipated for the 2080s in the table above shows the estimated attenuation volumes for the 1% AEP and 3.33% AEP rainfall events.					
Surface water: flood risk impacts from development site, mitigation & SuDS	As part of this Level 2 SFRA we have included calculations to provide an estimated land take if a pond with an assumed depth of 1.5m was included as part of the development. Attenuation volumes are presented for the critical storm duration for the 3.33% AEP event with exceedance flows quantified up to the 1% event. To prevent development worsening flood risk elsewhere, surface water runoff must be managed on site.					

RES-SA4.7 – SHLAA 4021 Land Off Dock Road South, Bromborough	
Flood Source: Groundwater	
Flood risk: groundwater	 **Figure 10: Susceptibility of groundwater flooding (BGS national dataset)** Based on geological and hydrogeological information, the BGS dataset can be used to identify areas where geological conditions could enable groundwater flooding to occur and where groundwater may come close to the ground surface. The dataset should not be used on its own to make planning decisions at any scale and should not be used to inform planning decisions at the site scale. The susceptibility data cannot be used on its own to indicate risk of groundwater flooding. The dataset shows that there is limited potential for groundwater flooding to occur across the majority of the site, with the exception of several small areas where there is potential for groundwater flooding of property situated below ground level.
Overall Site Assessment	
Access and egress	Based on the risk presented, safe access and egress routes should be possible to the south east of the site via Riverbank Road, or via The Power Station and Dock Road South.
Recommendation summary	Based on the evidence presented in the Level 1 SFRA and this Level 2 SFRA: - Early discussions should take place with the EA with regards to the tidal flood risk issues on this site. The EA offers early engagement through an advisory service via their website (https://www.gov.uk/guidance/developers-get-environmental-advice-on-your-planning-proposals) or by emailing the local office: SPPlanning.RFH@environment-agency.gov.uk. - Development should be directed to the area outside of the 0.5% AEP +climate change area. The risk area should be used for multifunctional

RES-SA4.7 – SHLAA 4021 Land Off Dock Road South, Bromborough	
	greenspace - A detailed drainage strategy should be carried out.
Can the second part of the Exception Test be satisfied?	Yes, assuming the above recommendations are fully considered.
FRA requirements	- The FRA should assess storage volumes for the recommended greenspace and design as required. - The FRA should include a drainage strategy for the proposed new development layout. - The FRA should include emergency planning procedures with consideration to ensuring safe access and egress routes in times of flood. - Any FRA should be carried out in line with the NPPF; FRCC-PPG; Local Plan and LLFA policies; and national and local SuDS policy and guidelines. - Throughout the FRA process, consultation should be carried out with the following, where applicable, the LPA; LLFA; emergency planning officers; EA; UU; the highways authorities; and the emergency services.

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Wirral Level 2 Strategic Flood Risk Assessment

Site RES-SA5.8

Draft Report

April 2022

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Revision History

Revision Ref / Date	Amendments	Issued to
V1.0 Draft September 2021	-	John Entwistle
V2.0 Draft December 2021	Council and EA comments addressed	John Entwistle
V3.0 Draft April 2022	Site boundary and area extended	John Entwistle
V4.0 Draft April 2022	Council comments addressed	John Entwistle

Prepared by ..... Hannah Bishop BSc MSc

Assistant Analyst

Reviewed by ..... Mike Williamson BSc MSc CGeog FRGS EADA

Principal Flood Risk Analyst

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SuDS	Sustainable Drainage Systems
UU	United Utilities
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RES-SA5.8: Former Dodds Builders Merchants, Bermuda Road, Moreton	
Location	Bermuda Road, Moreton
Site area (ha)	0.09
Watercourse	Arrowe Brook
EA Model used	Birket Fender and Arrowe Brook 2011
Existing use	Storage yard
Existing site flood risk vulnerability classification (NPPF)	Less vulnerable
Proposed use	Residential
Proposed development flood risk vulnerability classification (NPPF)	More vulnerable
Proposed development impermeable area (ha)	0.08

RES-SA5.8: Former Dodds Builders Merchants, Bermuda Road, Moreton

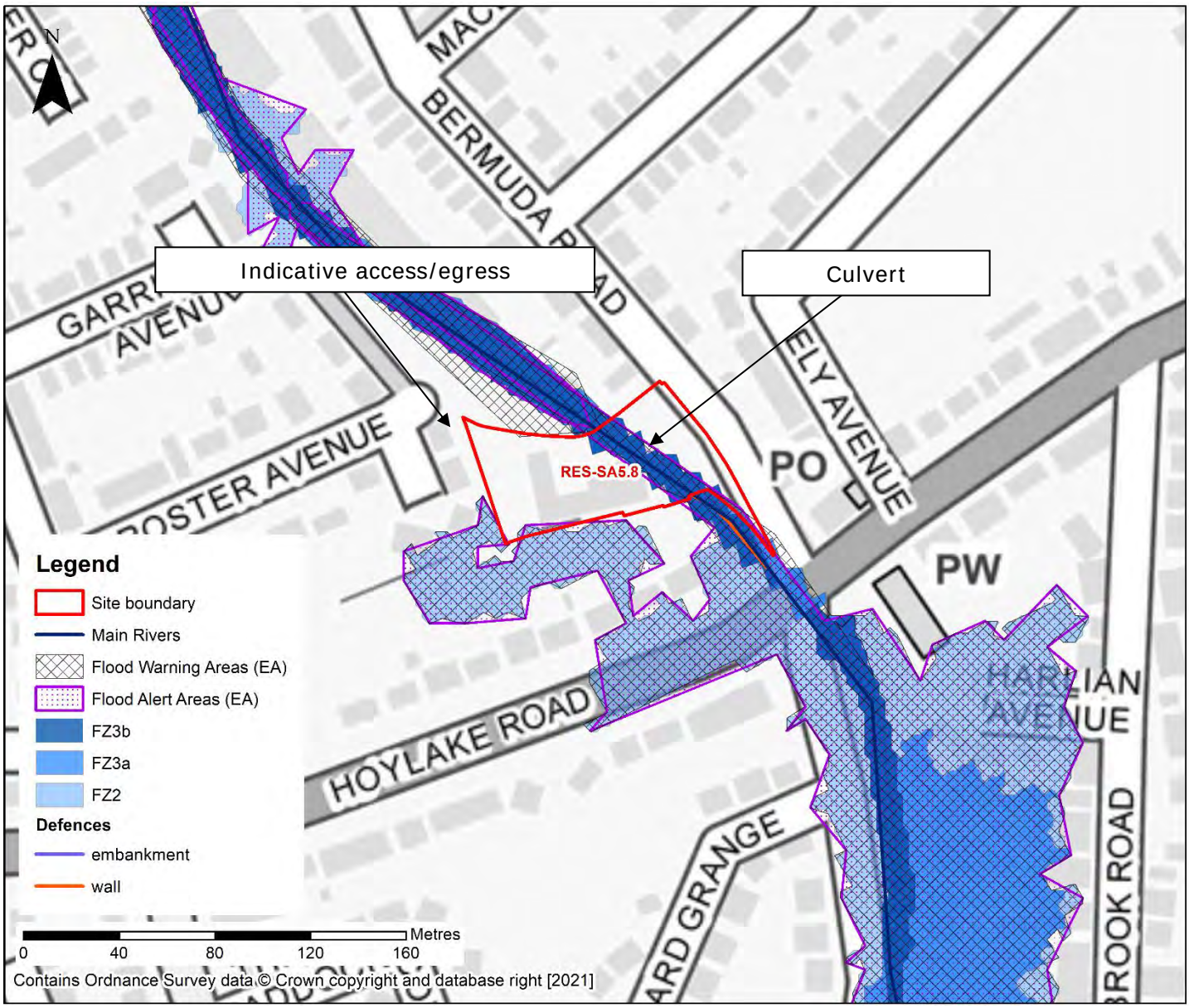

Figure 1: Existing fluvial flood zones and flood risk data

The Main River Arrowe Brook is culverted through the east of the site, entering from the southern boundary and exiting to the north. It is currently culverted from approximately 50m beneath an existing industrial building located within the site boundary. There is an unknown drain running along the southern boundary of the site. The site has a small area within Flood Zone 2 in the south of the boundary and is located within Flood Zone 3b where the channel runs through the site. The rest of the site being within Flood Zone 1. The site is partially within a FWA and a FAA.

RES-SA5.8: Former Dodds Builders Merchants, Bermuda Road, Moreton

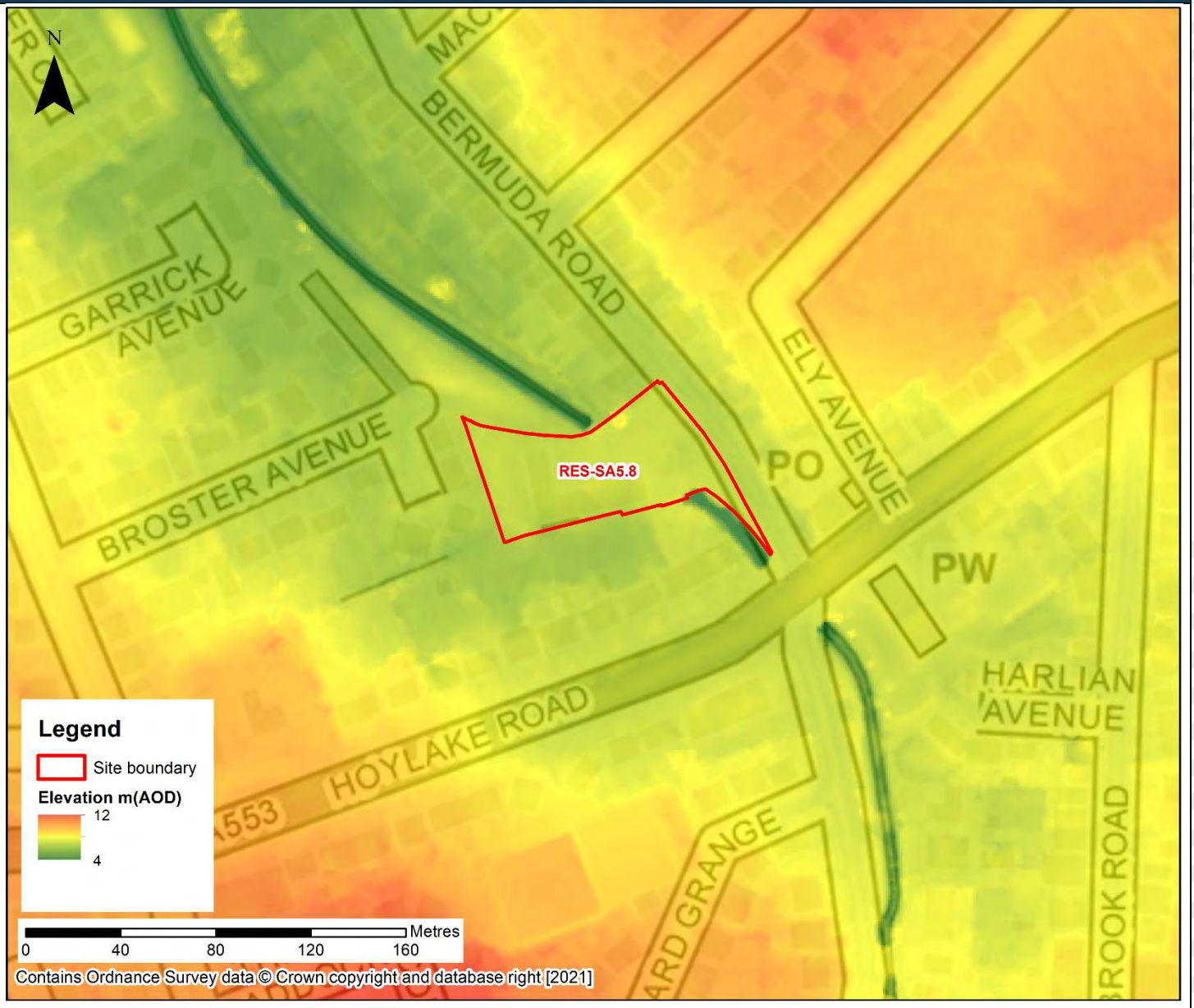

Figure 2: Topography

The elevation of the whole site does not vary substantially remaining at approximately 7.5 mAOD, with the highest point of elevation at 8.8m at the north of the site, which is consistent with the surrounding area. The elevation of Arrowe Brook is lower at approximately 5 mAOD.

Flood Source: Fluvial

Flood Zones	Flood Zone 3b	Flood Zone 3b +climate change*	Flood Zone 3a	Flood Zone 3a +climate change*	Flood Zone 2
	0.4%	+3.2%	3.2%	+6.9%	10.8%
Fluvial: maximum depth	0.4 m	0.5	0.5 m	0.8 m	1.1 m

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Flood Zone 3b figures stated based on defended model; Flood Zone 3a and 2 figures stated based on undefended model *Climate change figures based on central allowance (+44% on peak flows)	
Modelled fluvial risk including climate change on Arrowe Brook (Birket Fender and Arrowe Brook 2011 model) NOTE: modelled outputs for this SFRA are subtly different to original 2011 modelled outputs due to upgraded modelling and GIS software	

Figure 3: modelled flood outlines for central climate change allowance

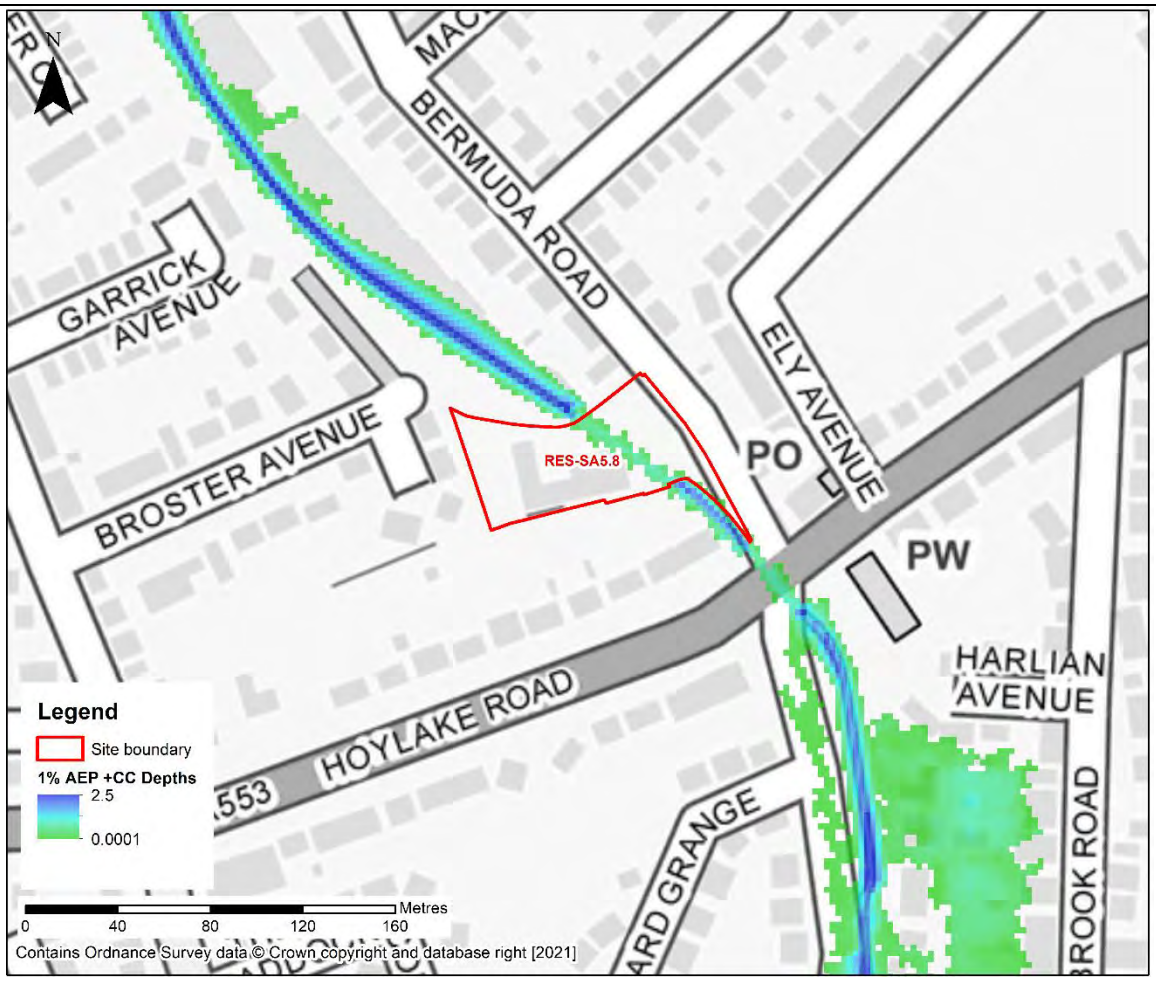
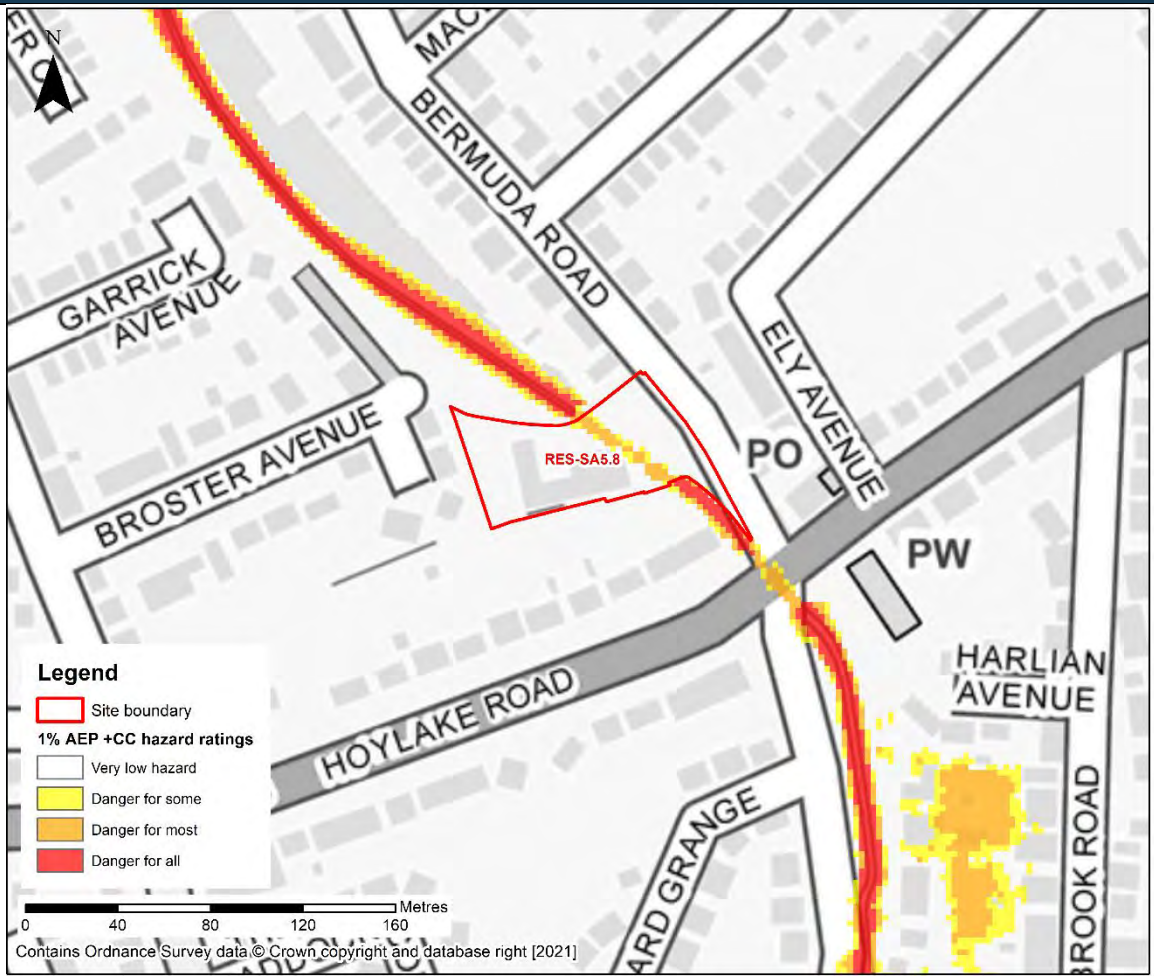


Figure 4: modelled fluvial flood depths (m) for 1% AEP + climate change event

RES-SA5.8: Former Dodds Builders Merchants, Bermuda Road, Moreton	
	 **Figure 5: modelled fluvial flood hazard for 1% AEP +climate change event** It is clear from the above figure that climate change will impact the site in the long term, however this impact remains localised around the culverted section of Arrowe Brook beneath the site. Fluvial depths within the site boundary reach a maximum of 0.5 m located at the southern boundary. Flood hazards across are mostly 'danger for most'.
Historic flooding	There are no areas of historic flooding that affect the site according to the EA's Historic Flood Map (HFM) dataset.
Defences	On the left bank of Arrowe Brook, which is closest to the site, there is a flood wall which has a design standard of 50 and a condition grade of 3 meaning Fair (Table 1.1 Condition Assessment Manual 2012[1]). This defence does not provide protection to the site.
Flood Warning Area	According to the EA's FWA dataset, there are two FWAs in operation. One in the south for the Irish Sea and Mersey Estuary from the Head of the Wirral to Runcorn affecting areas of Hoylake, Meols, Moreton and Wallasey. The other FWA covers a very small area in the north for Arrowe Brook at Moreton West.

1 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/291126/scho0509bqat-e-e.pdf

RES-SA5.8: Former Dodds Builders Merchants, Bermuda Road, Moreton	
Natural Flood Management / Working with Natural Process	The site lies outside the national scale 'potential for WwNP dataset'.
Observations, mitigation options & site suitability: fluvial	- The proposed use of development would see a change in risk classification from less vulnerable to more vulnerable according to the NPPF. - Given the change in use and therefore vulnerability of the site, 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 change of use meets the objectives of the Framework'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). - The ditch on the southern boundary will need assessing and any risk quantifying. - The site is located within Flood Zone 3b which is coincident with the culverted section of Arrowe Brook flowing beneath the site. No development is to be permitted within areas of Flood Zone 3b. - More vulnerable development would be appropriate to the west of Arrowe Brook, although development yields would likely be impacted in order to avoid the area of the site within Flood Zone 3b. The section of the site within Flood Zone 3b should remain as open greenspace and allowed to flood. - There is some additional risk to the site as a result of climate change, however as the risk remains centred around Arrowe Brook the same observations in terms of development apply. - A capacity and condition survey may be required for the culvert on Arrowe Brook as it may cause residual risk to the site if it becomes blocked. Development over the culvert is not permitted and options for removal should be investigated. - Safe access and egress should be possible via Broster Avenue or Bermuda Road as they are wholly within Flood Zone 1.
Flood source: infrastructure failure – reservoirs (residual)	
Flood risk: reservoir	There is no risk of flooding to the site as a result of dam failure, according to the EA's online RFM.
Flood source: infrastructure failure – canals (residual)	
Flood risk: canal	There are no canals in the vicinity of the site.
Flood source: surface water	
Surface Water Flood Risk to Proposed Development Site	

Current site: Risk of Flooding from Surface Water map	High Risk (3.3% AEP event)	Medium Risk (1% AEP event)	Low Risk (0.1% AEP event)
	7.4%	26.8%	68.9%
Surface water max flood depths	> 1.2 m	> 1.2 m	> 1.2 m

RES-SA5.8: Former Dodds Builders Merchants, Bermuda Road, Moreton

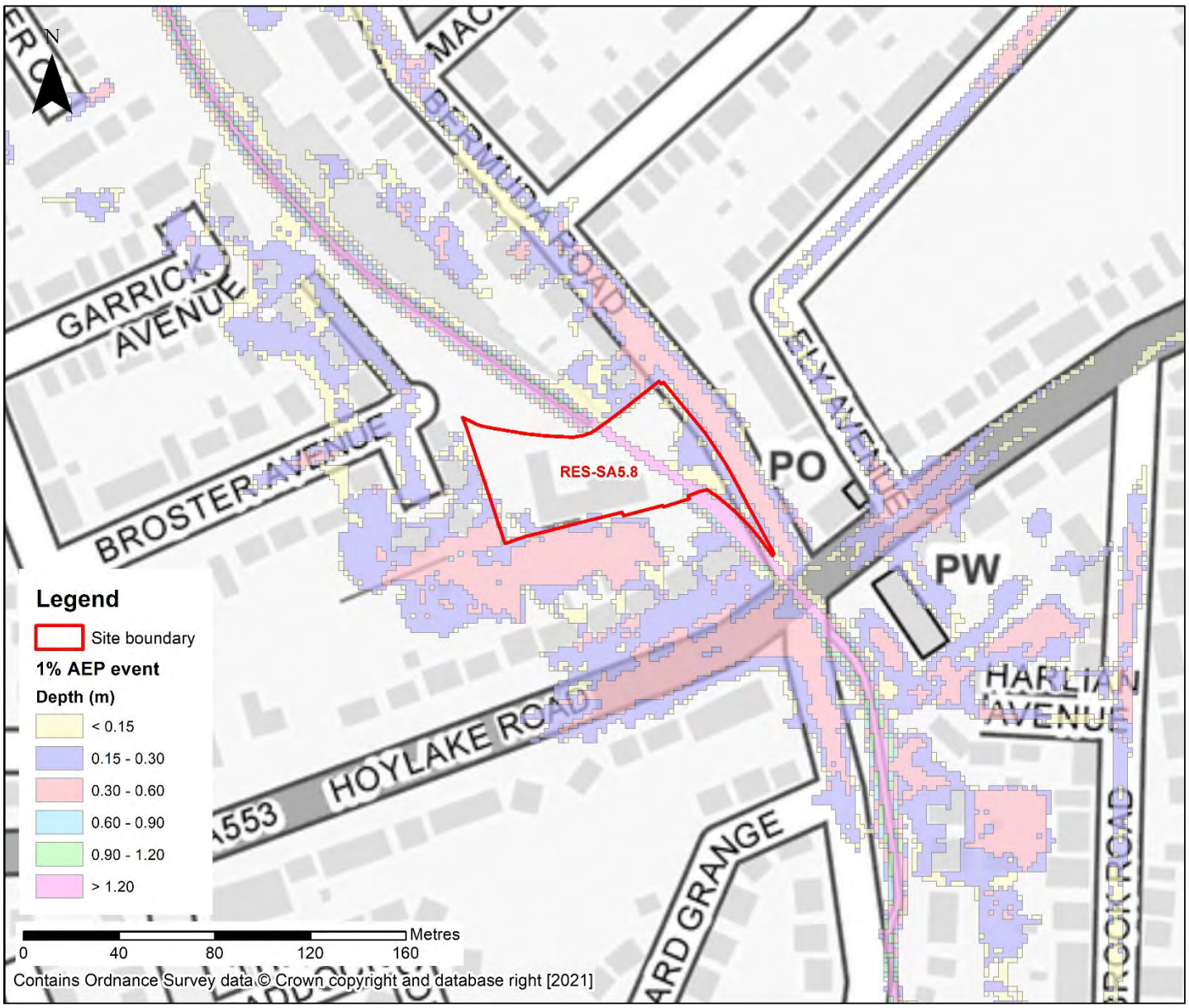


Figure 6: 1% AEP event surface water flood depths (Risk of Flooding from Surface Water map)

RES-SA5.8: Former Dodds Builders Merchants, Bermuda Road, Moreton

Figure 7: 1% AEP event surface water flood hazards (Risk of Flooding from Surface Water map)

**Surface water hazard rating based on Table 4.2 Hazard to People as a Function of Velocity and Depth, R&D OUTPUTS: FLOOD RISKS TO PEOPLE: PHASE 2 FD2321/TR2. Defra. March 2006.*

Surface water flood risk to development site	Approximately 26% of the site is at risk of surface water flooding in the 1% AEP event to a maximum depth of greater than 1.2 m with areas of extreme hazard. The risk is primarily localised to the culverted section of Arrowe Brook. However, safe access and egress may prove challenging as the land around the site is at risk. Broster Avenue and Bermuda Road are inundated during the 1% AEP event to a maximum depth of between 0.3 and 0.6 m with a moderate to significant hazard rating.

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Climate change	The current day 0.1% AEP event outline provides an indication of the likely increase in extent of the more frequent events. The 0.1% AEP event outline covers approximately 68% of the site with maximum depths of greater than 1.2 m with a hazard rating of significant to extreme. Broster Avenue and Bermuda Road become considerably inundated during the 0.1% AEP event with maximum depths of between 0.3 and 0.6 m and 0.6 to 0.9 m respectively. There would therefore not be a viable option for safe access and egress in the long term.

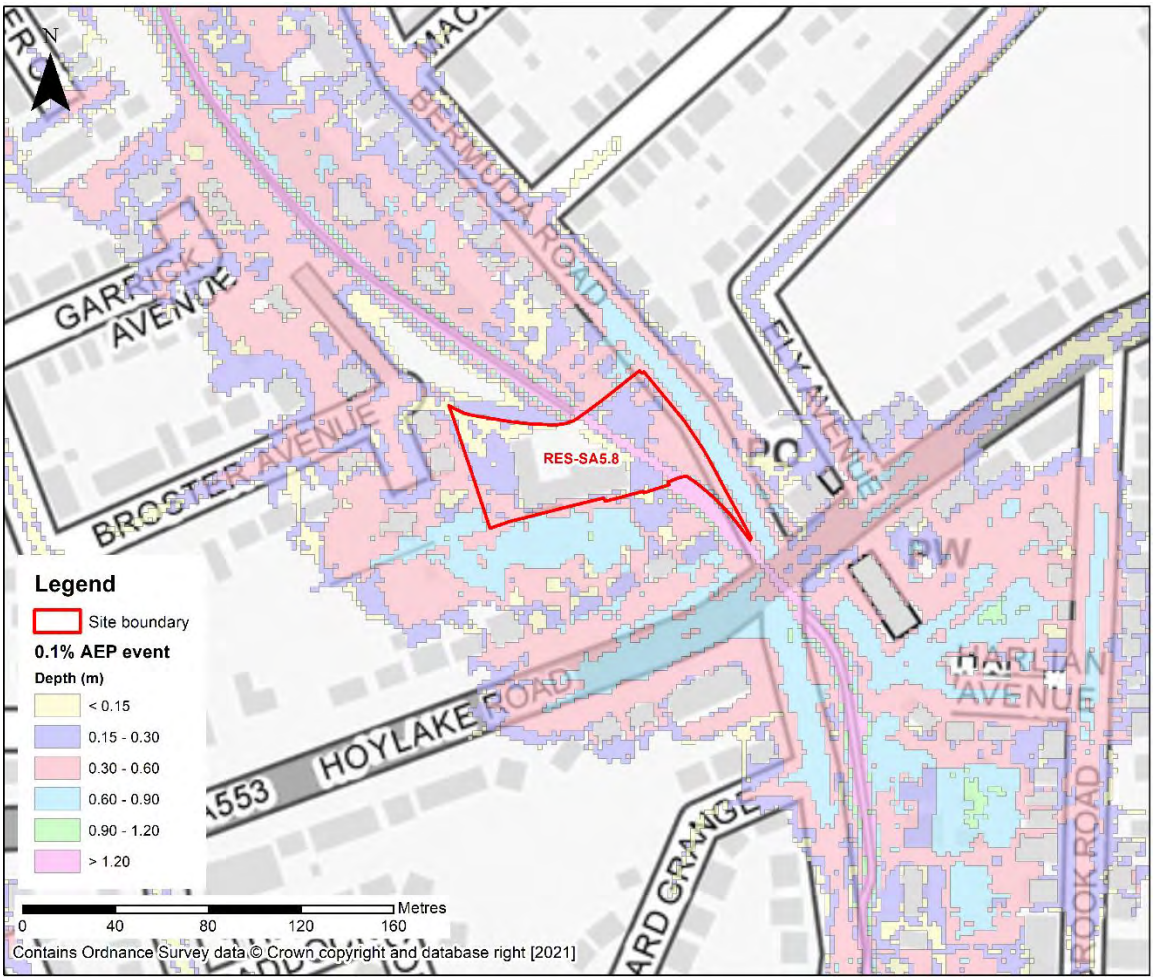
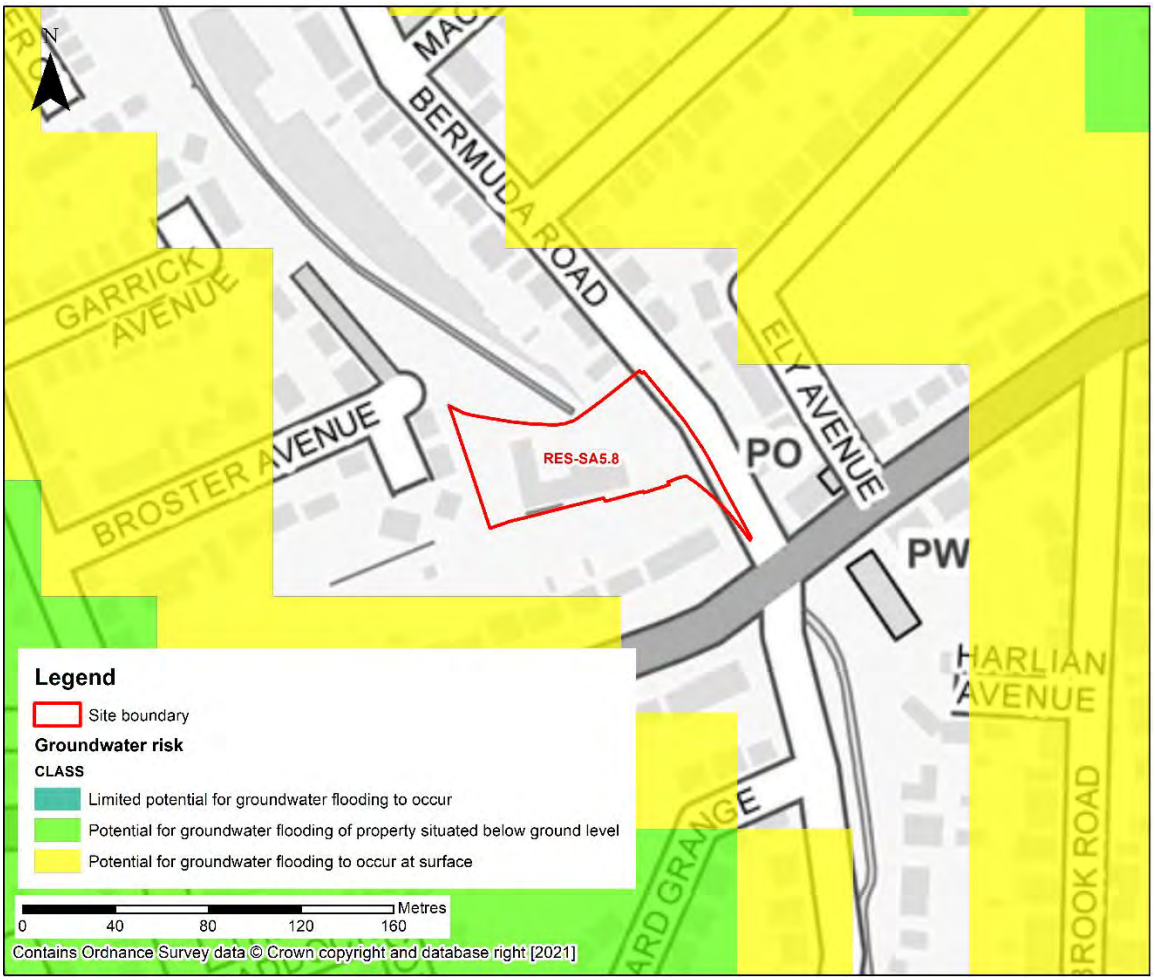


Figure 8: 0.1% AEP event surface water flood depths (Risk of Flooding from Surface Water map)

RES-SA5.8: Former Dodds Builders Merchants, Bermuda Road, Moreton	
	 **Figure 9: 0.1% AEP event surface water flood hazard (Risk of Flooding from Surface Water map)**
Mitigation options & site suitability: surface water	- When basing climate change impacts on the 0.1% AEP event of the RoFSW, this site could be at significant risk in the longer term. Although the RoFSW is not considered suitable for site-specific plan making, it does indicate here that more detailed investigation into surface water risk will be required through a drainage strategy. Surface water modelling will be required to show the site can remain safe and flood free for its lifetime which is 100 years for residential development. This also includes for the provision of safe access and egress routes at all times. - Judging from the mapping, the increased risk may, in part, be due to blockage of the nearby culvert on Arrowe Brook. Further investigation of the culvert is required. - Any access and egress routes would have to be raised above 600mm. - Full consultation with the LLFA will be required on this site were this site to be allocated.

RES-SA5.8: Former Dodds Builders Merchants, Bermuda Road, Moreton						
Surface Water Flood Risk from Proposed Development						
Runoff rates should not exceed current rates and if possible, betterment of existing rates should be aimed for. For the purposes of this assessment, the required volumes of attenuation have been calculated below based on an assumed 85% impermeable area and limiting greenfield runoff rate of Qbar (l/s).						
Proposed development limiting runoff rate: (l/sec) Qbar: 0.47 l/s (assume 5 l/s minimum discharge) (FEH Statistical) Q30: 0.79 l/s (assume 5 l/s minimum discharge) Q100: 0.97 l/s (assume 5 l/s minimum discharge)						
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
30yr Rainfall+20%	0.75	27	9	18	1.4	0.001 ha 1.333 %
30yr Rainfall+40%	0.75	32	9	22	1.8	0.001 ha 1.630 %
100yr Rainfall+20%	1	41	13	28 (10 exceedance storage)	2.2	0.002 ha 2.074 %
100yr Rainfall+40%	1	48	13	35 (13 exceedance storage)	2.8	0.002 ha 2.593 %
Climate change	Application of the central (+20%) and upper end (+40%) allowances for potential change anticipated for the 2080s in the table above shows the estimated attenuation volumes for the 1% AEP and 3.33% AEP rainfall events.					
Surface water: flood risk impacts from development site, mitigation & SuDS	As part of this Level 2 SFRA we have included calculations to provide an estimated land take if a pond with an assumed depth of 1.5m was included as part of the development. Attenuation volumes are presented for the critical storm duration for the 3.33% AEP event with exceedance flows quantified up to the 1% event. To prevent development worsening flood risk elsewhere, surface water runoff must be managed on site.					

RES-SA5.8: Former Dodds Builders Merchants, Bermuda Road, Moreton	
Flood Source: Groundwater	
Flood risk: groundwater	 **Figure 10: Susceptibility of groundwater flooding (BGS national dataset)** Based on geological and hydrogeological information, the BGS dataset can be used to identify areas where geological conditions could enable groundwater flooding to occur and where groundwater may come close to the ground surface. The dataset should not be used on its own to make planning decisions at any scale and should not be used to inform planning decisions at the site scale. The susceptibility data cannot be used on its own to indicate risk of groundwater flooding. The dataset shows that the site is not prone to groundwater flooding.
Overall Site Assessment	
Access and egress	Based on the risk presented, safe access and egress may prove difficult via Broster Avenue and Bermuda Road as they are modelled to flood during the surface water 1% and 0.1% AEP events to a maximum depth of between 0.6 and 0.9 m. Raised walkways may be required to keep escape routes dry however detailed modelling should inform this.
Recommendation summary	Based on the evidence presented in the Level 1 SFRA and this Level 2 SFRA: - Investigate residual risk from the Arrowe Brook culvert and the unnamed ditch. - Investigate removal of culvert. No development over the top of the culvert.

RES-SA5.8: Former Dodds Builders Merchants, Bermuda Road, Moreton	
	- FRA to include drainage strategy which should assess future risk and whether it can be managed onsite. This should include options for the provision of safe access and egress routes. - No development within the area of Flood Zone 3b towards the eastern boundary of this site. This area should be left as open greenspace and allowed to flood.
Can the second part of the Exception Test be satisfied?	Site not subject to the Exception Test though development may be permitted assuming it can be shown that surface water risk can be mitigated effectively onsite and included within the site design. If not, development of this site should not be permitted.
FRA requirements	- The FRA should include a detailed drainage strategy for the proposed new development layout including more detailed surface water modelling. Full consultation with the LLFA will be required. - Condition and inspection surveys of the culvert should be carried out and options for deculverting. - Quantify risk, if any, from the unnamed ditch. - The drainage strategy should include emergency planning procedures and ensuring safe access and egress routes in times of flood. - Any FRA should be carried out in line with the NPPF; FRCC-PPG; Local Plan and LLFA policies; and national and local SuDS policy and guidelines. - Throughout the FRA process, consultation should be carried out with the following, where applicable, the LPA; LLFA; emergency planning officers; EA; UU; the highways authorities; and the emergency services.

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