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Level 2 Strategic Flood Risk Assessment

Site HEA042

Prepared for: Southend-on-Sea City Council

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1 Background

This is a Level 2 Strategic Flood Risk Assessment (SFRA) site screening report for HEA042. The content of this Level 2 SFRA site screening report assumes the reader has already consulted the Southend-on-Sea City Council Level 1 SFRA and read the Southend-on-Sea City Council Level 2 SFRA Main Report and is therefore familiar with the terminology used in this report.

1.1 Site details

- Location: Southend Central, Former Gas Works (Esplanade House)
- Site area: 1.27ha
- Existing site use: Brownfield, currently a car park
- Proposed site use: Mixed-use (residential, commercial, public parking)

1.2 Topography

Figure 1-1 shows the topography of the site represented by the Environment Agency (EA) 1m resolution LiDAR.

The site is situated on relatively flat, low-lying topography. There is approximately 2m difference between the lowest (2.95mAOD) and highest (4.09mAOD) ground level across the site.

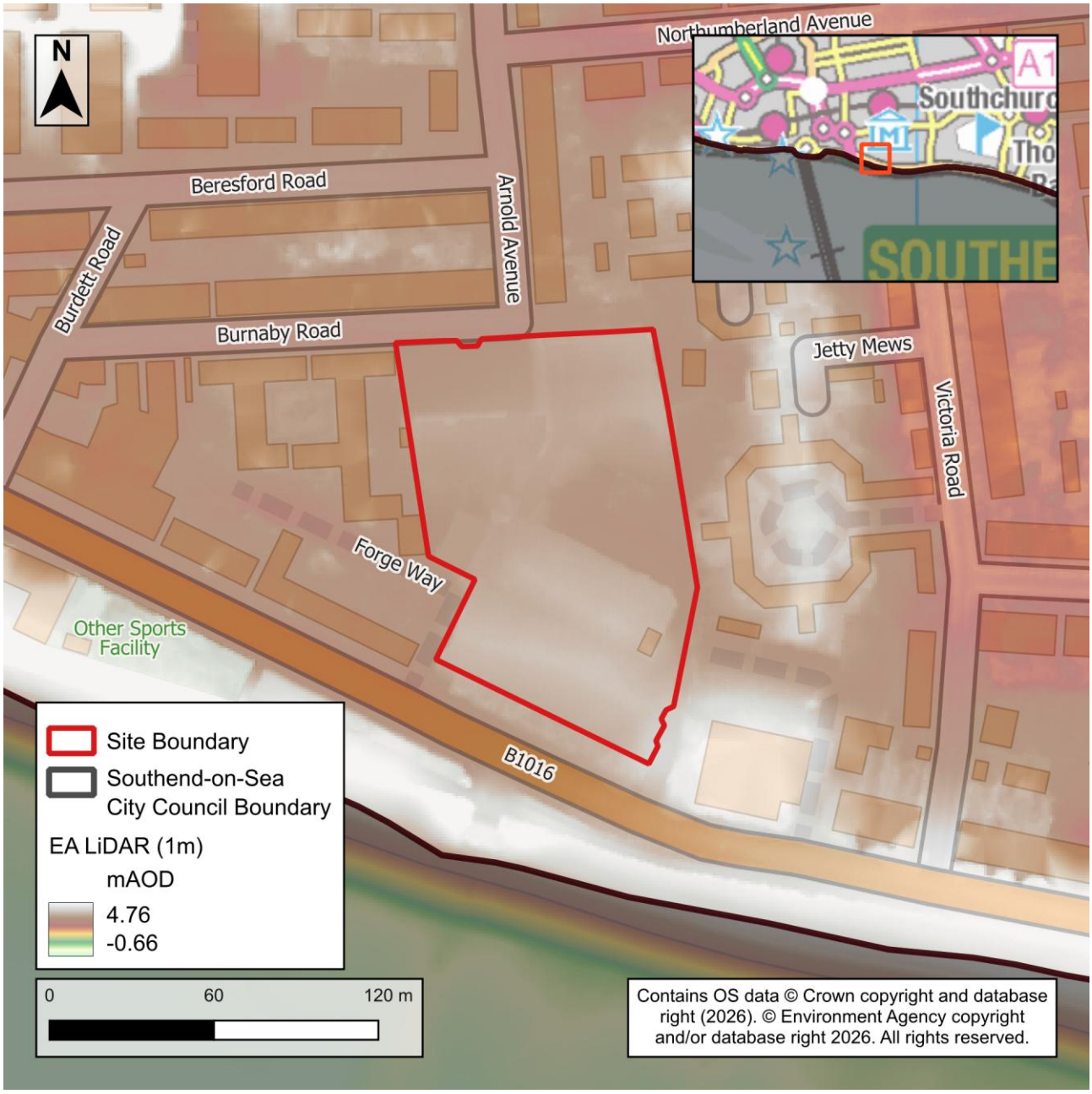


Figure 1-1: Topography of the site.

1.3 Geology and soils

Geology at the site consists of:

- Bedrock - London Clay Formation made up of clay, silt and sand
- Superficial - North of site: Tidal flat deposits made up of clay and silt
  South of site: Blown sand

Soils at the site consist of loamy and clayey soils of coastal flats with naturally high groundwater.

The likely impact of these on drainage within the site is discussed within Section 5.

2 Sources of flood risk

2.1 Location of site within the catchment

The site is located within the south of the study area. The site drains directly to the Thames Estuary.

2.2 Existing drainage features

Based on online mapping, there are no existing drainage features within the site. However, as the existing land use is brownfield, there is likely to be existing drainage infrastructure present within the site.

The site is approximately 60m north of the Thames Estuary.

There is an unnamed watercourse which originates approximately 2km northeast of the site and flows in a south-westerly direction flowing as an open channel through the Thorpe Bay residential area and through Thorpe Hall Golf Course. The watercourse enters a culvert approximately 700m east of the site and discharges south into the Thames Estuary.

There is a lake located approximately 200m east of the site in Southchurch Park.

2.3 Fluvial and tidal

2.3.1 EA's Flood Map for Planning

Based on the EA's Flood Map for Planning (FMfP) Flood Zones (accessed 21 April 2026) and Flood Zone 3b (functional floodplain) defined in the Southend-on-Sea Level 1 SFRA, the percentage areas of the site within each Flood Zone are stated in Table 2-1 and can be viewed in Figure 2-1. The FMfP does not consider the benefits from flood defence infrastructure.

Flood Zone 3b is not shown to be present at the site. The entire site is located within either Flood Zone 3a or Flood Zone 2. Flood Zone 3a flows across the centre of the site. The northwest corner of the site is also located within Flood Zone 3a. The rest of the site is located within Flood Zone 2.

Table 2-1: Present day fluvial flood risk based on the EA's FMfP *.

Flood Zones	Flood Zone 3b (%)	Flood Zone 3a (%)	Flood Zone 2 (%)	Flood Zone 1 (%)
Percentage of site at risk* (%)	0	40	60	0

** This shows the percentage of the site at flood risk from a particular flood zone or event, including the percentage of the site at flood risk at a higher risk zone, e.g. Flood Zone 2 includes the Flood Zone 3a and 3b percentage. Flood Zone 1 + Flood Zone 2 = 100%.*

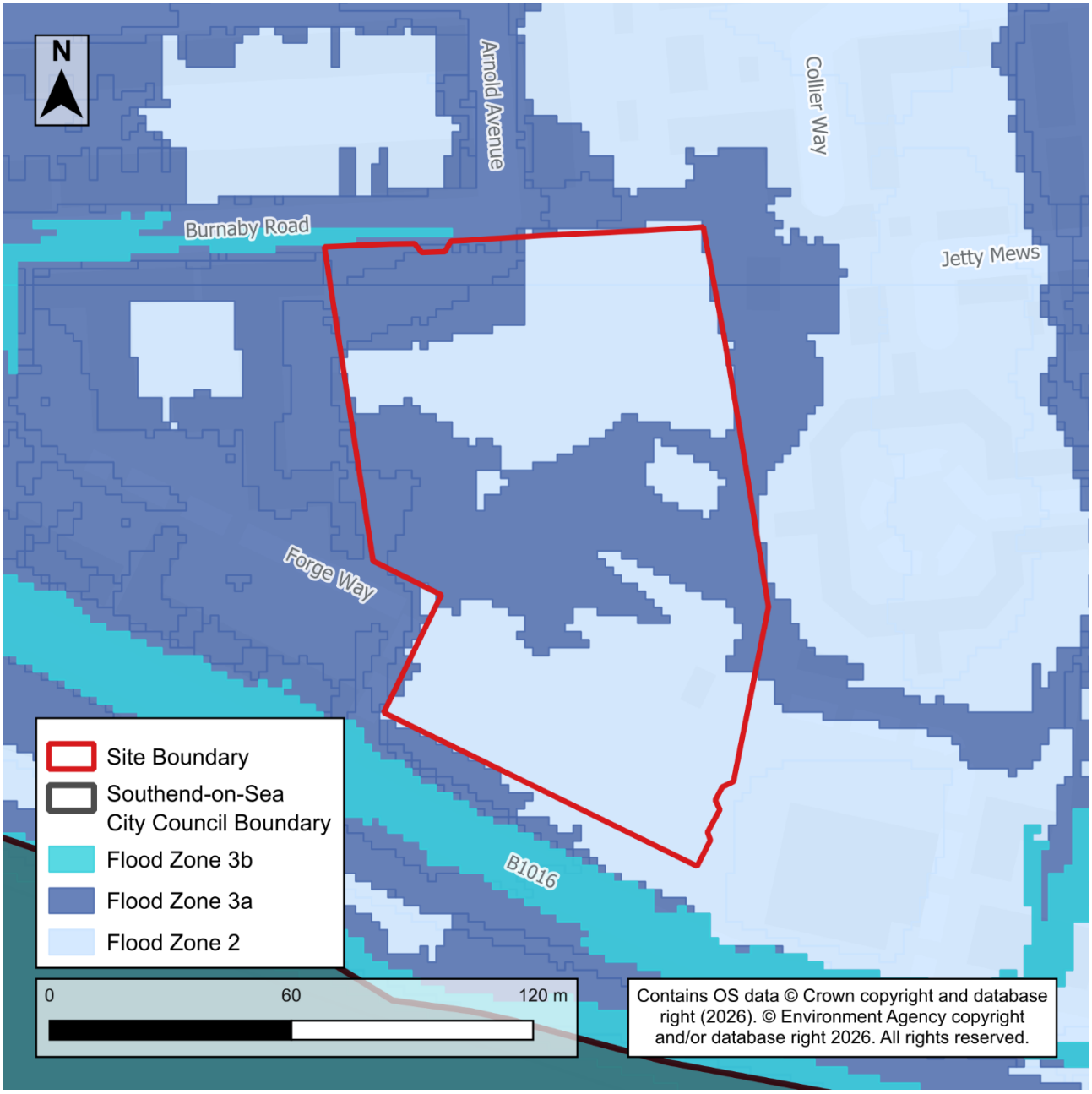


Figure 2-1: Flood Zones as shown within the EA Flood Mapping.

2.3.2 Fluvial

The EA's FMfP has been used within this assessment to assess fluvial risk as there is no detailed hydraulic modelling currently available for this site. Flood Zone 3b has been defined using the Rivers and Sea 3.3% AEP defended extent. There is currently no available depth, hazard, or velocity information available within the EA FMfP, therefore, detailed hydraulic modelling is likely to be required during a site-specific Flood Risk Assessment.

The fluvial risk to the site results from the unnamed watercourse described in Section 2.2. The watercourse is culverted when it exits the golf course in the west and there is a risk of

the site being impacted by overland flows. However, the predominant risk to this site is tidal risk from the Thames Estuary which is also shown in this dataset.

No fluvial model data is available to assess the implications of climate change on fluvial risk.

2.3.3 Tidal - present day (2026 epoch)

As part of this SFRA, the existing EA detailed hydraulic models of Southend and the Crouch and Roach estuary developed as part of the 2014 Essex, Suffolk and Norfolk Coastal modelling project were combined. The updated model has been used to assess the tidal risk to the site.

This site is shown to benefit from defences along the Thames Estuary which are described in Section 3.1. This section summarises both the defended and undefended risk.

Undefended

The undefended tidal risk across the site is shown in Figure 2-2. The site is at significant tidal risk in the undefended scenarios. In the 0.5% AEP scenario, maximum depths exceed 1.20m in the east and northwest, are between 0.90m and 1.20m across the northern and central areas of the site and are between 0.60m and 0.90m in the south of the site. Maximum velocities are between 1.00m/s and 2.00m/s in the south of the site. Maximum hazard classification is 'Danger for All' across most of the site, with a small area in the west classified as 'Danger for Most'.

In the 0.1% AEP scenario, the entire site as depths exceeding 1.20m and a hazard classification of 'Danger for Most'.

Defended

The defended tidal risk across the site is shown in Figure 2-3. The site is not shown to be at risk during most of the defended scenarios. There is risk along the B1016 to the south of the site, but this is only shown to encroach slightly in the southwest of the site during the 0.1% AEP event.

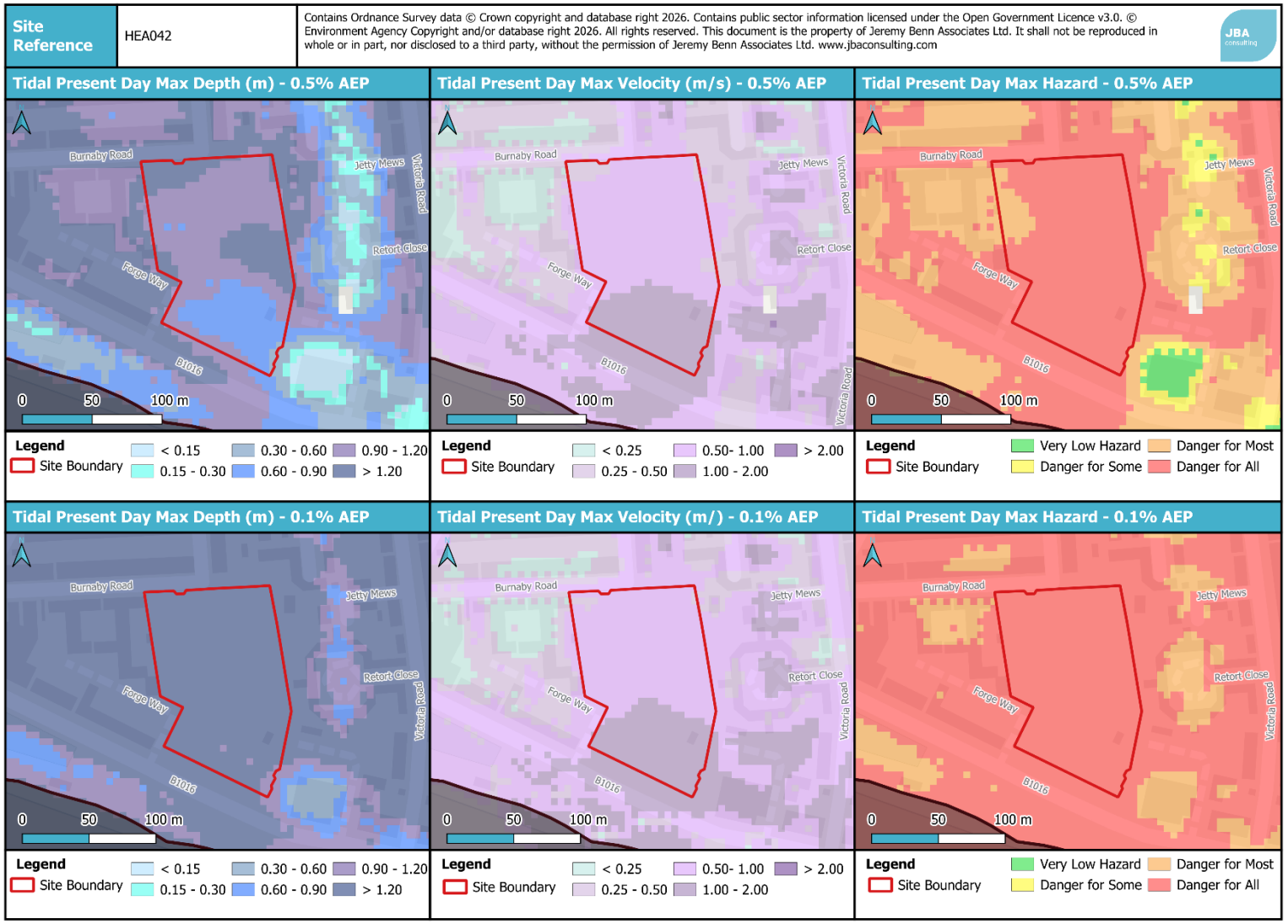


Figure 2-2: Present day tidal modelling for the 0.5% AEP and 0.1% AEP undefended events.

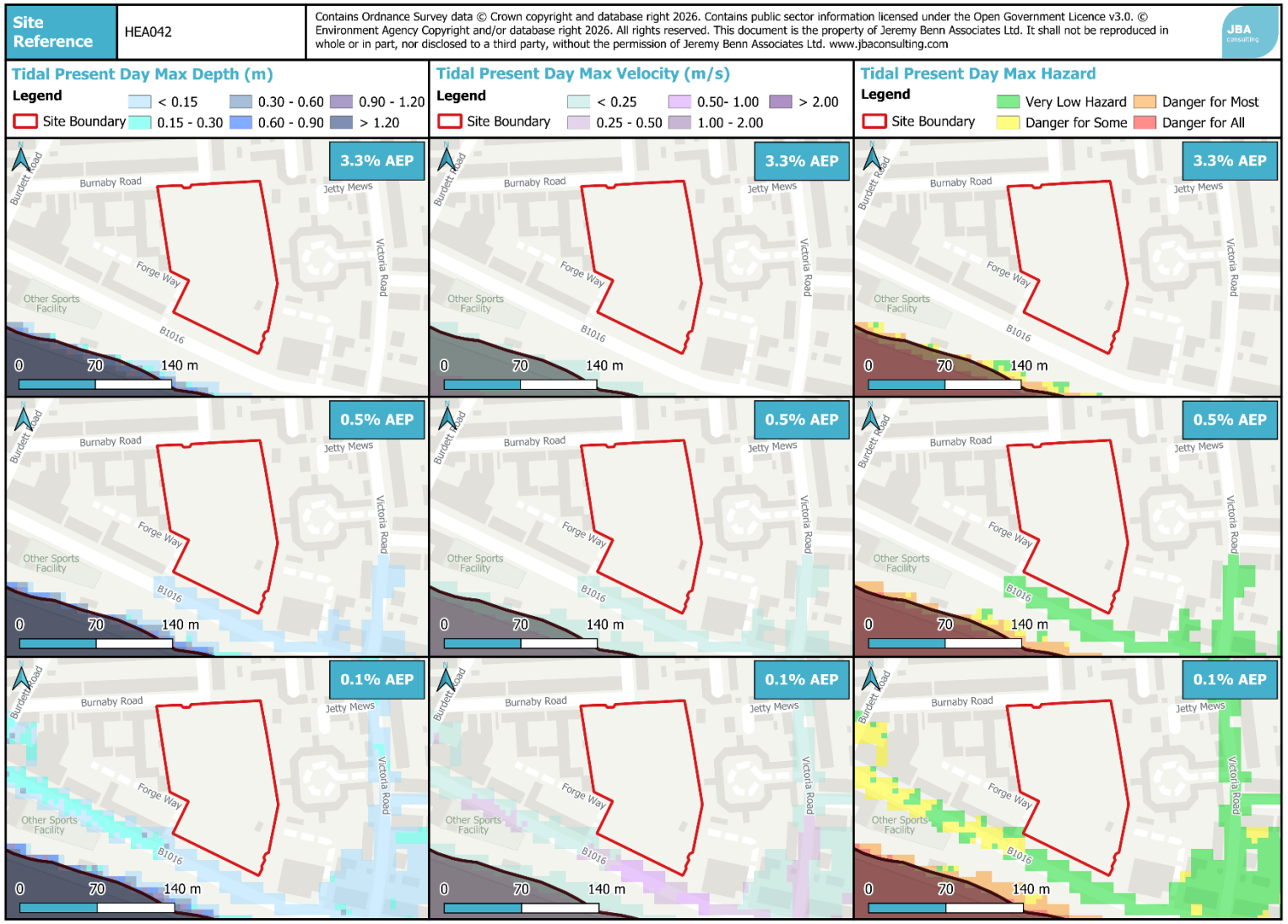


Figure 2-3: Present day tidal modelling for the 3.3% AEP, 0.5% AEP, and 0.1% AEP defended events.

2.3.4 Tidal - future risk (2126 epoch)

The detailed tidal hydraulic model updated as part of this SFRA (see Section 2.3.3 for further details) was uplifted for the 2126 epoch for the higher central and upper end climate change scenarios.

Undefended risk

Figure 2-4 and Figure 2-5 show the undefended tidal risk predicted across the site. The entire site is at significant tidal risk in both undefended scenarios with hazard classification of 'Danger for All' across the site.

Maximum depths are found along the northern site boundary, and minimum and maximum predicted depths are shown in Table 2-2.

Table 2-2: Minimum and maximum depths predicted at the site in the tidal undefended climate change scenarios.

Assessment category	0.5% AEP higher central CC	0.5% AEP upper end CC	0.1% AEP higher central CC	0.1% AEP upper end CC
Minimum depth (m)	1.80	2.18	2.16	2.54
Maximum depth (m)	2.74	3.11	3.09	3.47

Defended risk

Figure 2-6 and Figure 2-7 show the defended tidal risk predicted across the site. The site is not shown to be at tidal risk in the 3.3% AEP higher central event, but the entire site is shown to be at risk in all other events.

The 3.3% AEP upper end and 0.% AEP higher central climate change scenarios show similar risk to the site. Maximum depths are between 0.60m and 0.90m in the northern and central areas of the site. Velocities are mostly below 0.25m/s and hazard classification is largely 'Danger for Some'.

In the larger events the entire site is at significant risk with hazard classification of 'Danger for All'. Minimum and maximum predicted depths are shown in Table 2-3: Minimum and maximum depths predicted at the site in the tidal undefended climate change scenarios.

Table 2-3: Minimum and maximum depths predicted at the site in the tidal undefended climate change scenarios.

Assessment category	0.5% AEP upper end CC	0.1% AEP higher central CC	0.1% AEP upper end CC
Minimum depth (m)	1.96	2.14	2.54
Maximum depth (m)	2.89	3.08	3.47

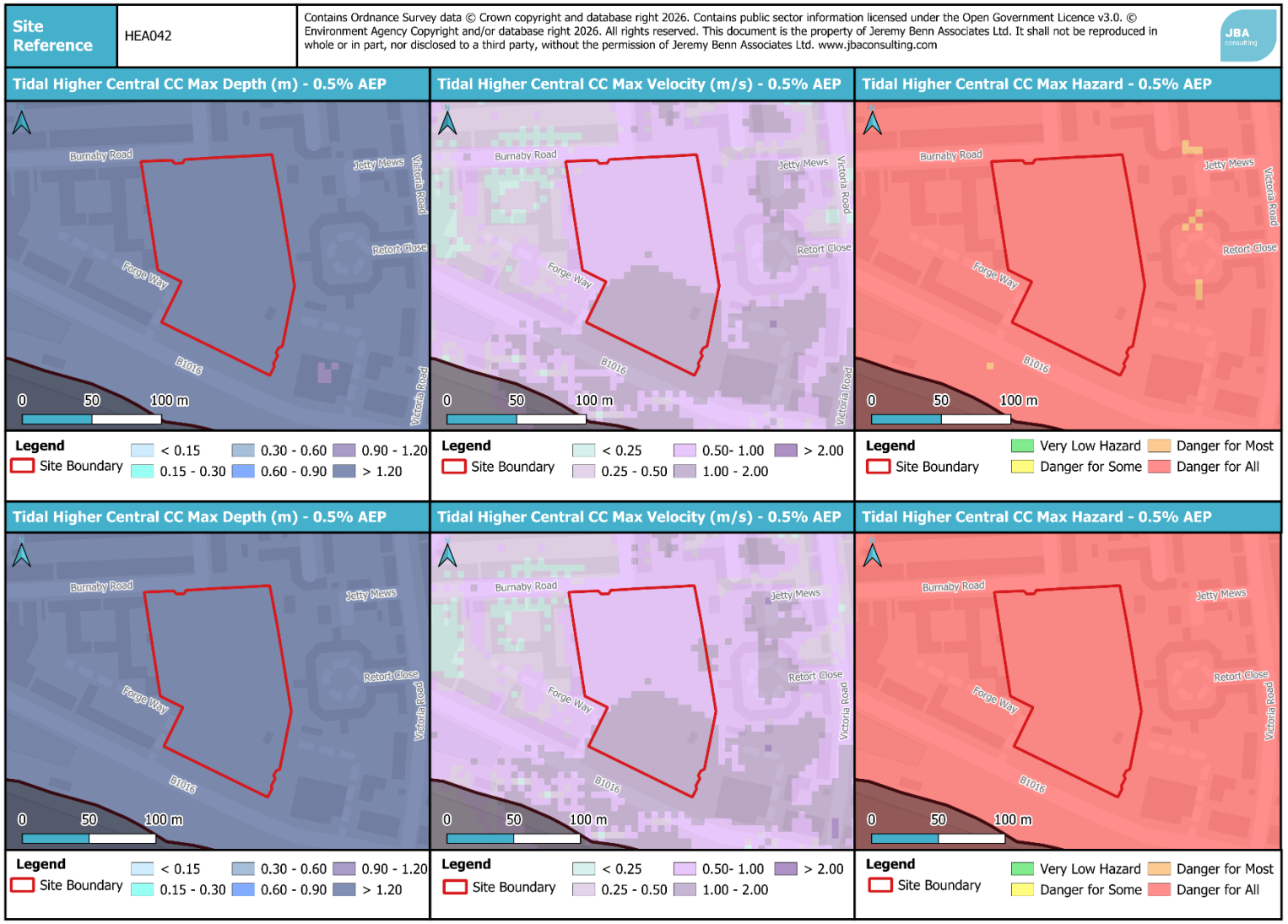


Figure 2-4: Tidal risk for the 0.5% AEP and 0.1% AEP higher central climate change undefended scenarios.

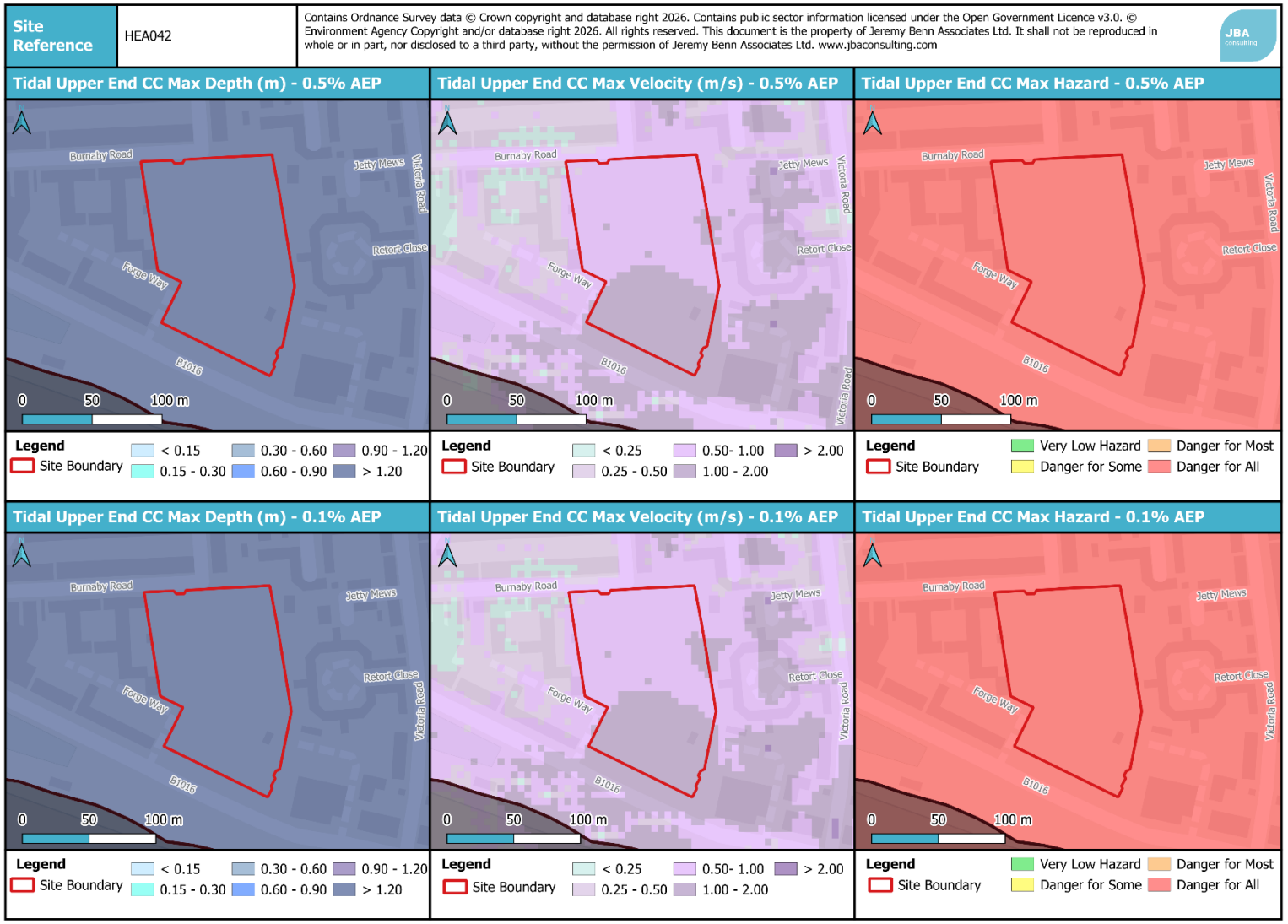


Figure 2-5: Tidal risk for the 0.5% AEP and 0.1% AEP upper end climate change undefended scenarios.

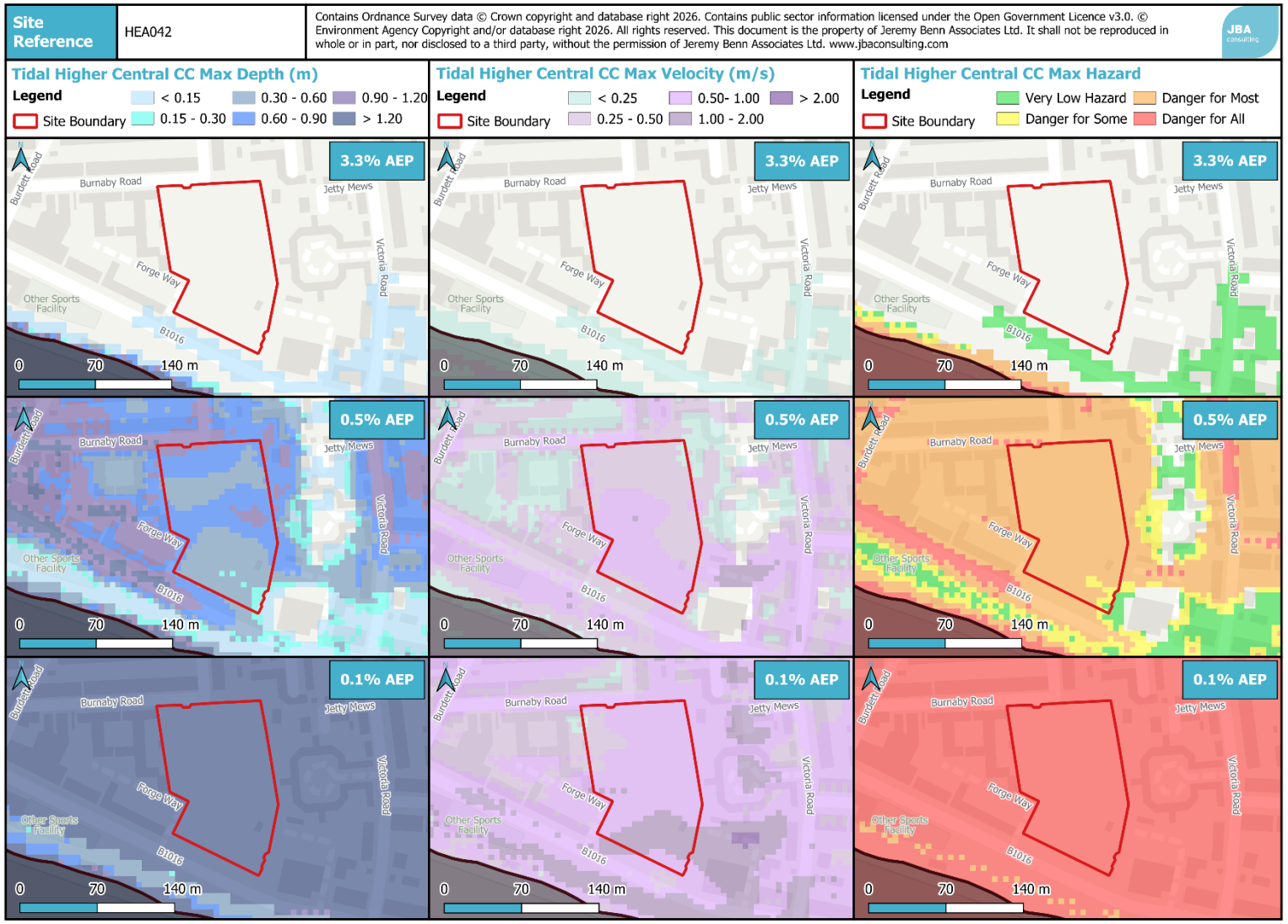


Figure 2-6: Tidal risk for the 3.3% AEP, 0.5% AEP and 0.1% AEP higher central climate change defended scenarios.

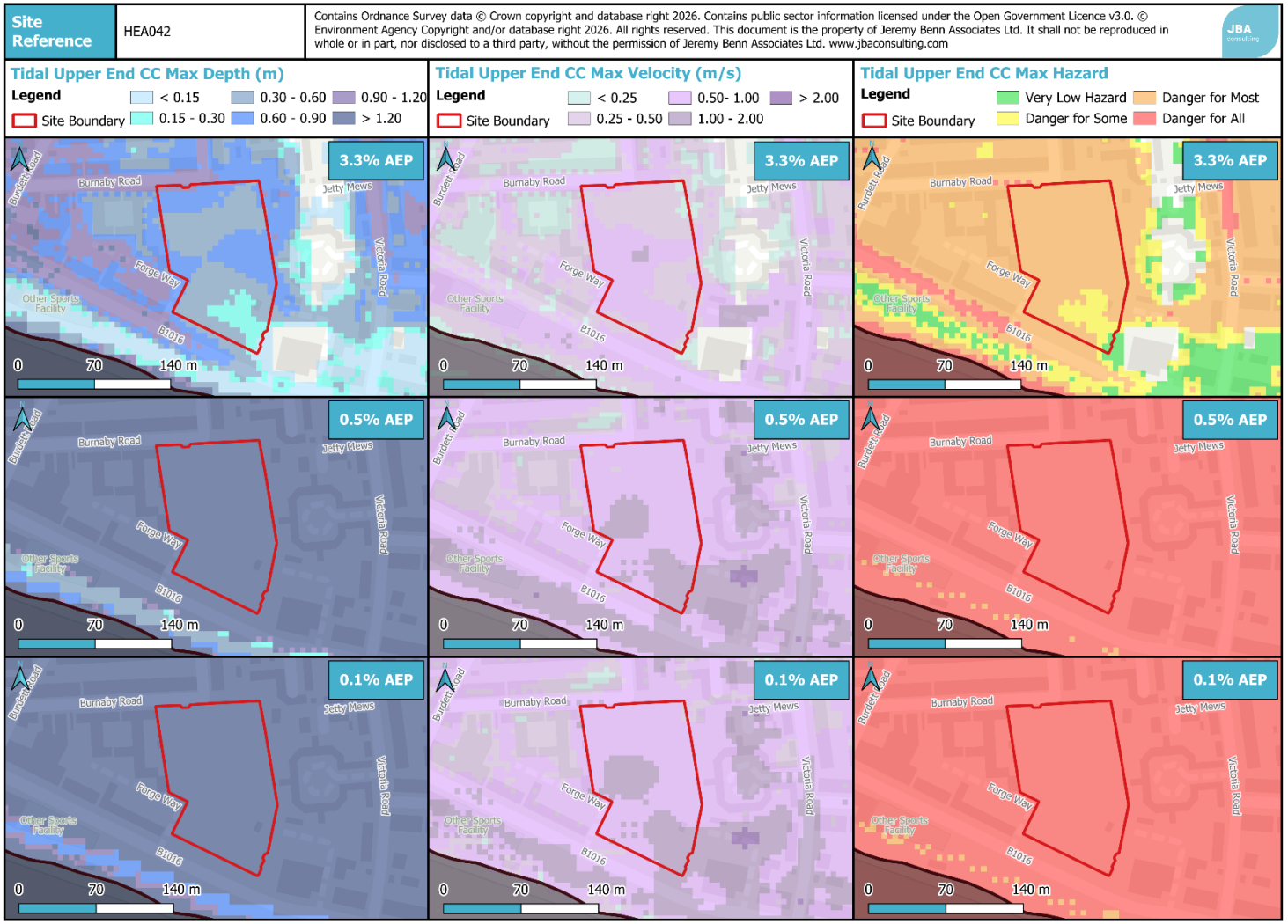


Figure 2-7: Tidal risk for the 3.3% AEP, 0.5% AEP and 0.1% AEP upper end climate change defended scenarios.

2.4 Surface water

2.4.1 Available data

The EA's FMfP Surface Water Spatial Planning Dataset, released in May 2026, has been used within this assessment to inform the extent and depth of the present day and future surface water risk. Climate change outputs are available for the 3.3%, 1%, and 0.1% AEP events with the Upper End climate change allowance for the 2070s epoch.

The Risk of Flooding from Surface Water (RoFSW) map has been used within this assessment to inform the velocity and hazard of the present day surface water risk. There is currently no available velocity or hazard information to use to assess future surface water risk.

Descriptions refer to the maximum depth, velocity, and hazard values experienced in each area of the site within a given event.

2.4.2 Present day

Figure 2-8 shows that there are two areas of ponding in the centre and east of the site during the 3.3%, 1% and 0.1% AEP events. There is a further small area of ponding in the south of the site during the 1% and 0.1% AEP. And a further two areas at risk in the west and northwest of the site during the 0.1% AEP event.

Figure 2-9 shows depth, velocity and hazard data. Flooding is shown to be deepest in the east of the site, where depths are shown to exceed 0.3m. Velocities are only shown to exceed 0.5m/s in a very small area in the west of the site during the 0.1% AEP event. Velocities are shown to remain below 0.25m for a majority of the flooding. The east, west and northwest corner of the site are shown to pose a 'Danger for Some' during the 0.1% AEP event. The rest of the flooding is shown to pose a 'Very Low Hazard'.

Table 2-4: Present day surface water flood risk based on the EA's FMfP Surface Water Spatial Planning dataset (extent, depth) and RoFSW dataset (velocity, hazard).

Assessment category	3.3% AEP	1% AEP	0.1% AEP
Percentage of site at risk* (%)	5	10	25
Maximum depth (m)	0.15 - 0.30	0.15 - 0.30	0.30 - 0.60
Maximum velocity (m/s)	0.25 - 0.50	0.25 - 0.50	0.50 - 1.00
Maximum hazard classification	Very Low Hazard	Very Low Hazard	Danger for Some

** The percentage surface water extents quoted show the percentage of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. the 1% AEP includes the 3.3% AEP percentage).*

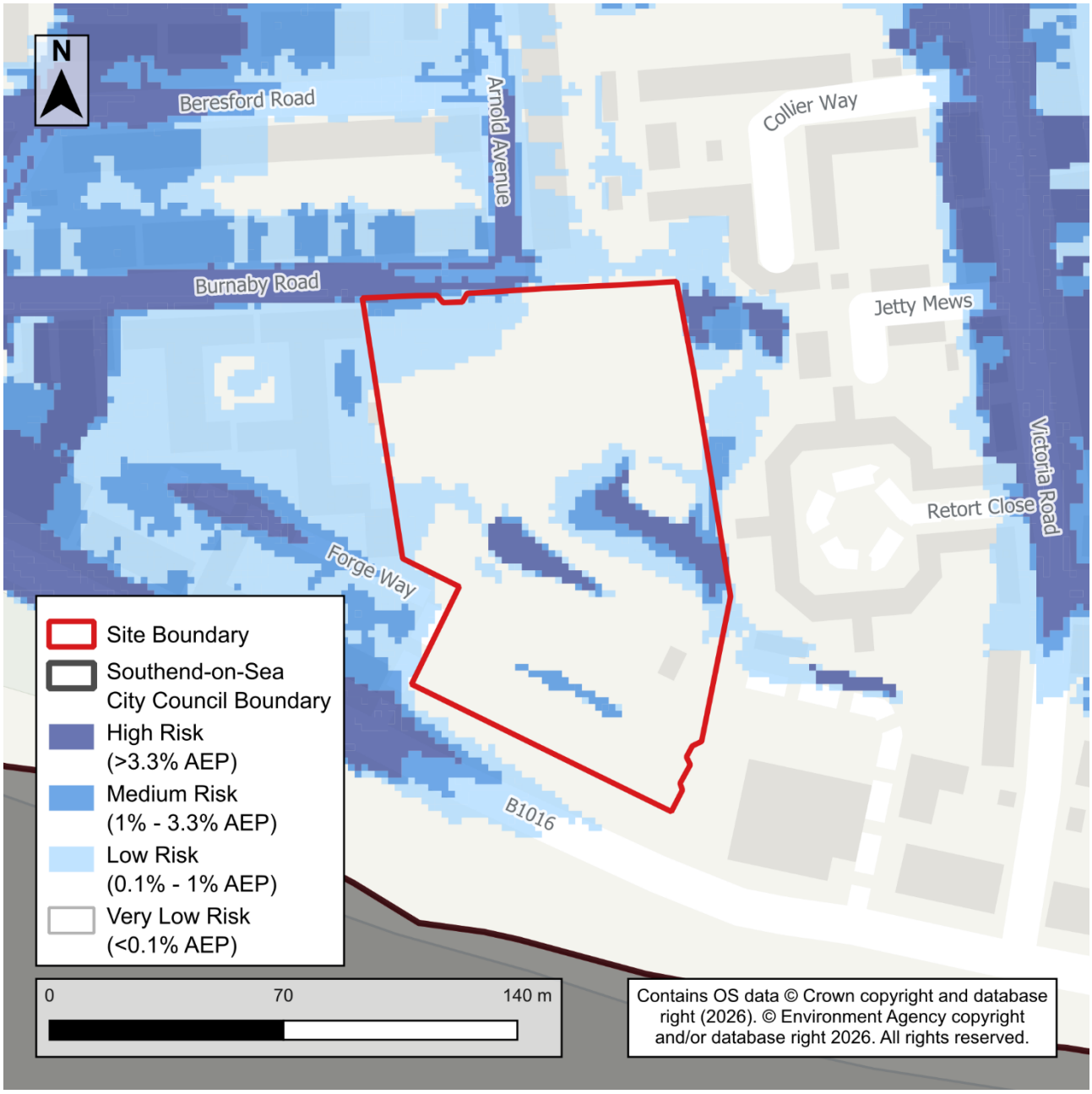


Figure 2-8: Present day surface water risk, based on the EA FMfP Surface Water Spatial Planning dataset.

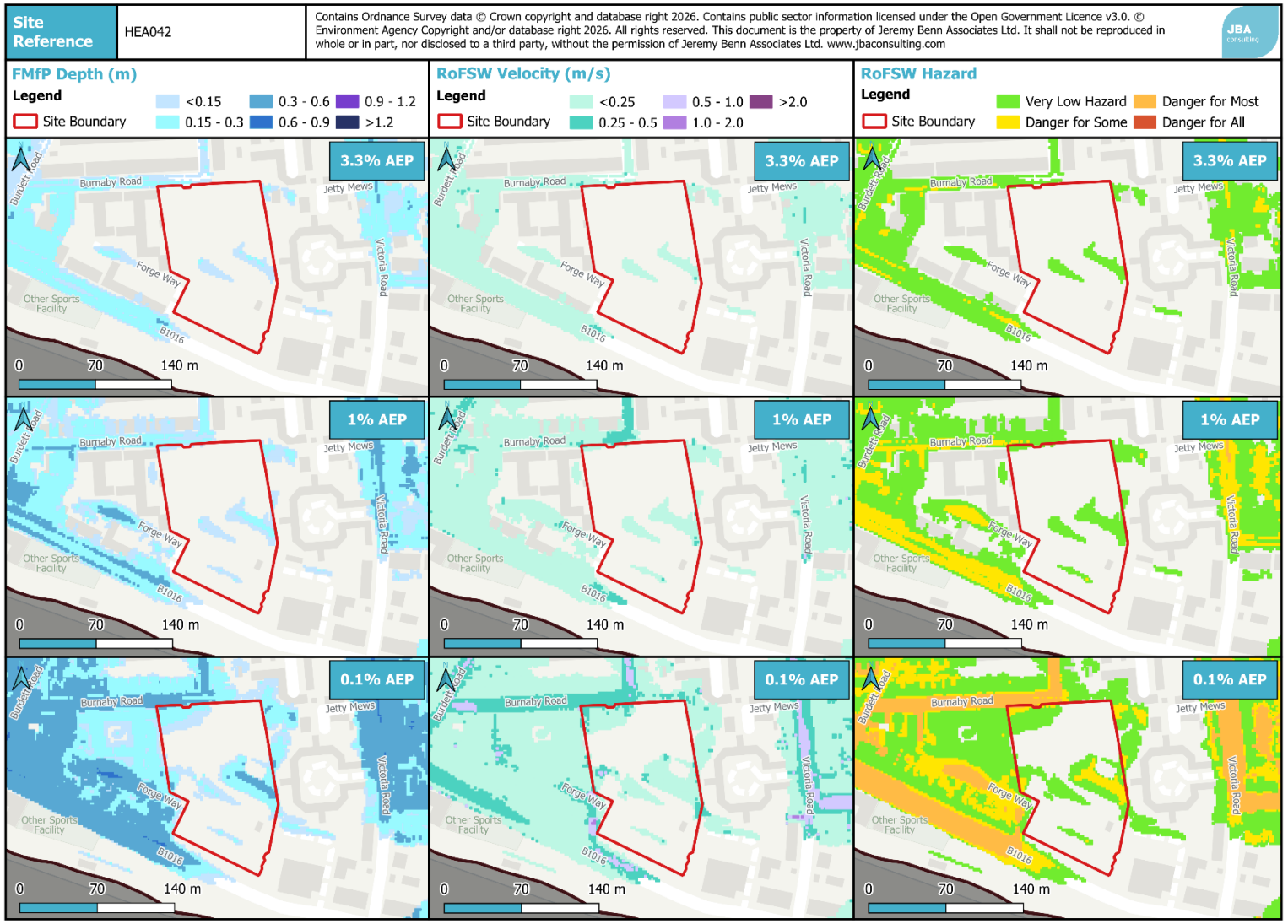


Figure 2-9 Present day surface water risk in the 3.3%, 1%, and 0.1% AEP events.

2.4.3 Climate change - 2070s Upper End

As shown in Figure 2-10, the extent of the future 3.3% AEP event is very similar to that of the present day 1% AEP event. The west and northwest of the site are now shown to be at risk during the future 1% AEP event. The future 0.1% AEP event now shows the majority of the site to be at risk, with only the northeast, southwest and southeast corners not becoming inundated.

Flooding in the future 3.3% and 1% AEP events is still shown to remain below 0.3m. A larger area in the east, west and northwest of the site are shown to exceed 0.3m in depth during the future 0.1% AEP event.

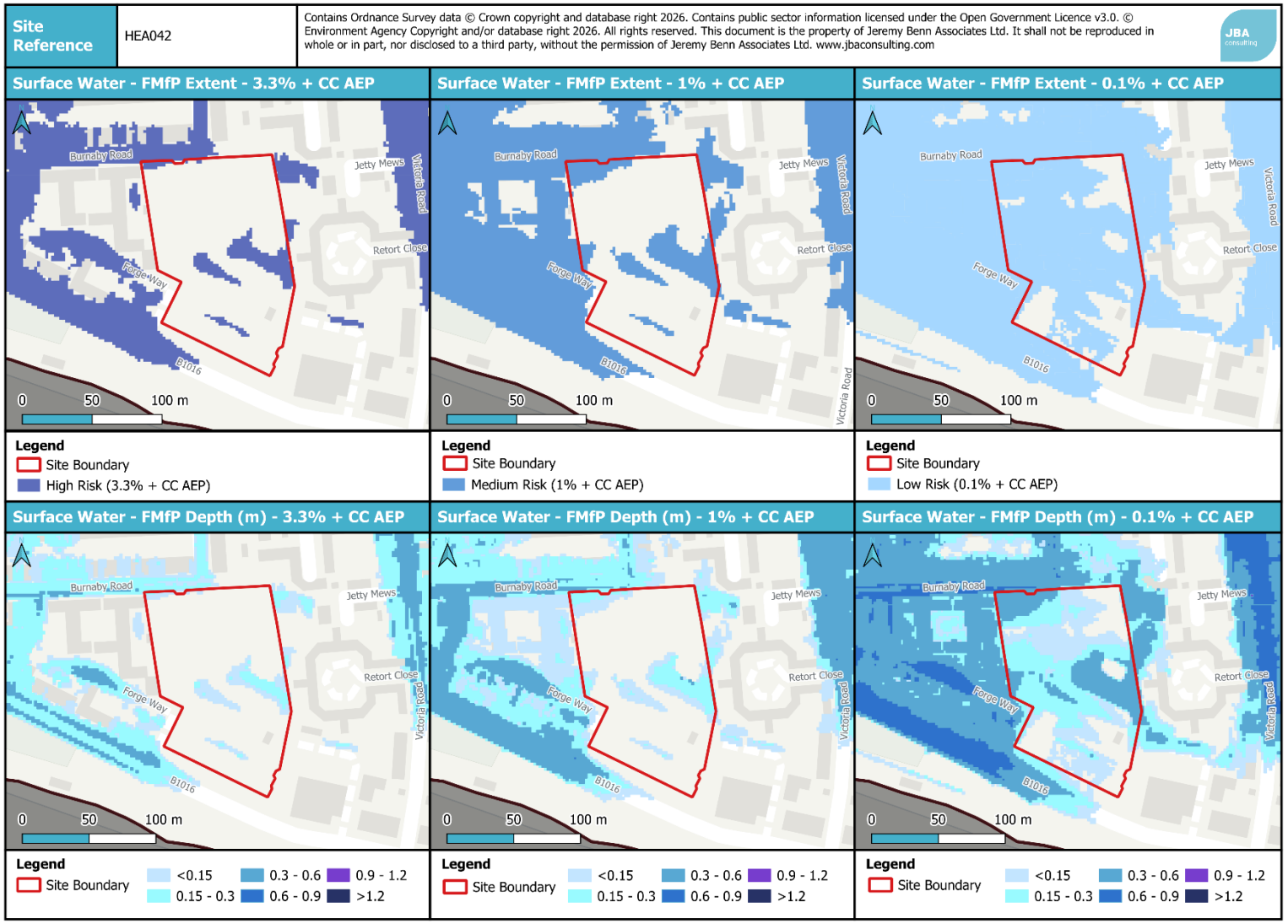


Figure 2-10: Extents and depths of surface water risk in the 3.3%, 1%, and 0.1% AEP Upper End climate change scenarios.

2.5 Groundwater

The JBA Groundwater Emergence Map, mapped in Figure 2-11, shows that the groundwater levels to the south of the site are predicted to be between 0.5m and 5m below the ground surface in a 1% AEP groundwater flood event. In this area there is a risk of flooding to subsurface assets, but surface manifestation of groundwater is unlikely.

The JBA Groundwater Emergence Map also shows that the majority of the site northwards of this has a negligible risk from groundwater flooding due to the nature of the local geological deposits.

This assessment does not negate the requirement that an appropriate assessment of the groundwater regime should be carried out at the site-specific Flood Risk Assessment (FRA) stage.

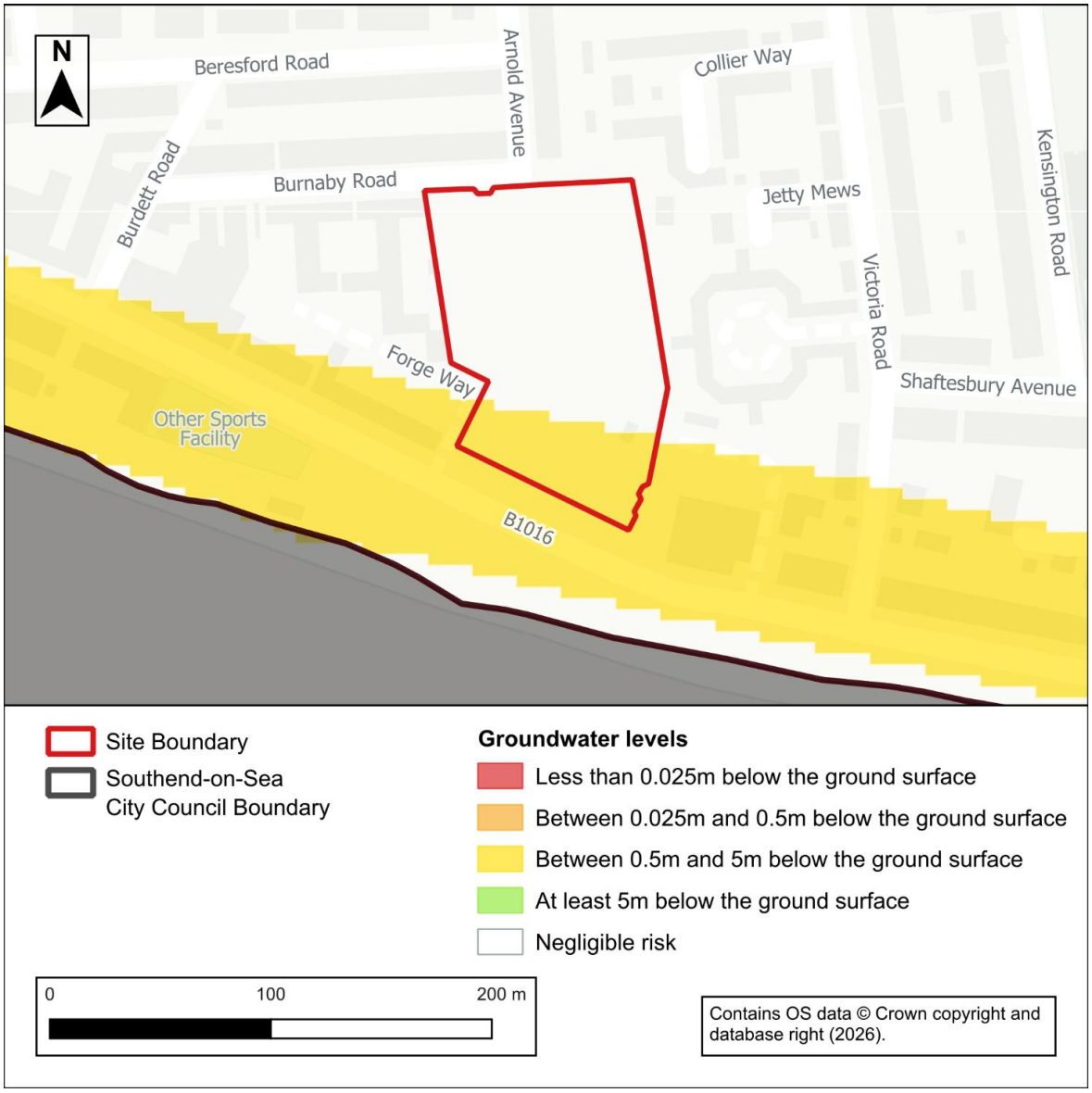


Figure 2-11: Predicted groundwater levels across the site in a 1% AEP groundwater flood event, based on the JBA Groundwater Emergence Map

2.6 Sewers

Anglian Water provided a redacted GDPR compliant version of their DG5 dataset for the study area, which identifies internal and external historic sewer flooding records between 2022 and 2026.

Records show two sewer flooding incidents in close proximity to the site. One incident was located approximately 80m east of the site. This incident occurred in 2024 and is reported to have been external only flooding. The other incident was located approximately 60m northwest of the site, occurred in 2025 and is reported to have also been external only flooding.

The available data should always be supplemented by direct consultation with Anglian Water to ascertain if there is any site-specific risk from a public sewer. This is because sewer flood risk information is not publicly available and would need to be considered on a site-specific basis.

2.7 Flood history

The EA's Historic Flood Map shows one flood event impacting the entire site. The flood event occurred in 1953. The source of flooding is listed as the sea.

Data provided by Essex County Fire and Rescue Service shows no records of flooding at the site.

3 Flood risk management infrastructure

3.1 Defences

The EA AIMS dataset, mapped in Figure 3-1, shows that the site is protected by a coastal flood wall to the south. The flood wall is privately owned and is designed to provide protection against a 0.1% AEP tidal event.

As discussed in Sections 2.3.3 and 2.3.4, detailed hydraulic modelling shows the site is offered protection from the defences, with the site not shown to be at risk during the 3.3% AEP and 0.5% AEP present day scenarios, and 3.3% AEP higher central climate change scenarios. Significant depths are experienced across the site in the defended climate change scenarios for the 0.5% AEP and 0.1% AEP events.

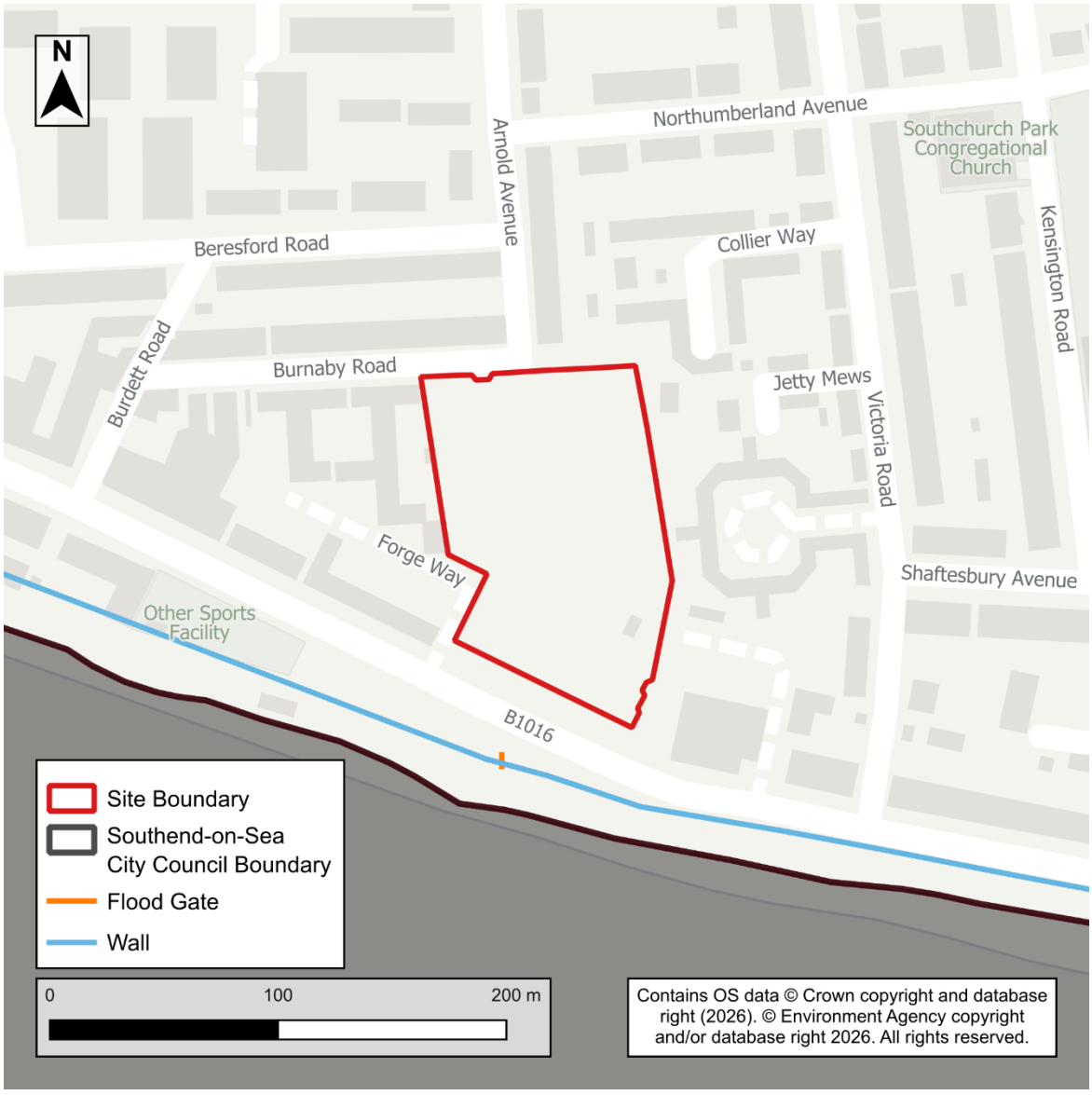


Figure 3-1: Flood defences as shown within the EA AIMS dataset.

3.2 Residual risk

Breach modelling has been carried out for the 3.3%, 1%, and 0.1% AEP events for present day and climate change scenarios for the higher central and upper end scenarios for the 2126 epoch. Three breach locations were considered. Details of the breach locations and scenarios are provided in Appendix D.

This site is shown to be impacted by tidal flooding from all three breach locations, during most modelled scenarios.

Table 3-1 provides the approximate rate of onset (time between the breach and the first flooding experienced at the site) and the maximum duration of the flooding at the site.

Breach one

The site is not predicted to be at risk in the present day scenarios, until the 0.1% AEP event, or the 3.3% AEP higher central climate change scenario. In the 0.1% AEP present day, 3.3% AEP upper end and 0.5% AEP higher central climate change scenarios there is a lead time of approximately 14 hours providing longer warning time, with a maximum flooding duration of around 30 hours. The larger climate change events have a much shorter lead time of 2 to 3 hours and a maximum duration of up to around 44 hours.

Breach two

The site is not predicted to be at risk in the present day scenarios, until the 0.1% AEP event, or the 3.3% AEP higher central climate change scenario. Similarly to breach one, the 3.3% AEP upper end and 0.5% AEP higher central climate change scenarios provide warning time with a rate of onset of 12 to 13 hours. The larger events have a shorter lead time with the 0.1% AEP event at around 2 hours and approximately 1 hour for the climate change events.

Breach three

Breach three presents the greatest risk to the site. The site is not at risk in the 3.3% AEP present day scenario, but in all other scenarios this breach shows the fastest rate of onset of less than 12 minutes across giving little to no lead time. The maximum duration is up to 45 hours.

Table 3-1: Maximum depth, velocity, hazard, and rate of onset and duration of flooding for each breach scenario where the site is shown to be at risk of tidal flooding.

Breach	Event	Maximum depth (m) (2dp)	Maximum velocity (m/s) (2dp)	Maximum hazard (2dp)	Rate of onset (hours) (1dp)	Maximum flooding duration (hours) (1dp)
1	3.3% AEP Upper End CC	0.99	1.08	1.84	14.7	31.2
1	0.5% AEP Higher Central CC	1.06	1.03	1.91	14.3	31.4
1	0.5% AEP Upper End CC	2.89	1.33	4.23	2.7	43.2
1	0.1% AEP	0.00	0.07	0.72	13.5	31.5
1	0.1% AEP Higher Central CC	3.08	1.24	4.38	3.0	42.9
1	0.1% AEP Upper End CC	3.47	1.35	3.79	2.5	43.7
2	3.3% AEP Upper End CC	0.99	1.08	1.84	12.7	31.2
2	0.5% AEP Higher Central CC	1.06	1.03	1.91	12.3	31.4
2	0.5% AEP Upper End CC	2.89	1.33	4.23	1.0	43.2
2	0.1% AEP	0.00	0.07	0.72	1.8	31.5
2	0.1% AEP Higher Central CC	3.08	1.24	4.38	1.0	42.9
2	0.1% AEP Upper End CC	3.47	1.35	3.79	0.8	43.7
3	3.3% AEP Higher Central CC	1.00	0.86	1.81	0.1	43.6
3	3.3% AEP Upper End CC	1.47	0.99	2.54	0.1	44.0
3	0.5% AEP	0.11	0.13	0.90	0.0	30.7
3	0.5% AEP Higher Central CC	1.50	1.00	2.59	0.0	43.9
3	0.5% AEP Upper End CC	3.05	1.18	4.57	0.1	44.3
3	0.1% AEP	0.71	0.83	1.59	0.1	31.6
3	0.1% AEP Higher Central CC	3.10	1.18	4.47	0.0	44.2

Breach	Event	Maximum depth (m) (2dp)	Maximum velocity (m/s) (2dp)	Maximum hazard (2dp)	Rate of onset (hours) (1dp)	Maximum flooding duration (hours) (1dp)
3	0.1% AEP Upper End CC	3.47	1.25	4.38	0.2	44.6

4 Emergency planning

4.1 Flood warnings and alerts

The site is located in the Essex coast at Shoeburyness to Southend Pier EA Flood Warning Area and The Essex coast from Shoeburyness, to and including Southend seafront, including Southchurch Park Flood Alert Area.

4.2 Access and escape

Safe access and escape will need to be demonstrated in the 1% AEP plus climate change fluvial and surface water events and the 0.5% AEP plus climate change tidal event. Site drainage proposals should address the requirements for access routes, avoid impeding surface water flows and preserve the storage of surface water to avoid exacerbation of flood risk elsewhere on the site and in the wider catchment.

4.2.1 Potential access

Access to the site is via Eastern Esplanade (B1016) to the south and Burnaby Road to the north. All access routes are potentially impeded by the tidal risk to the site. Access from the north and west is also impeded by the surface water risk surrounding the site, but access and escape from the southwest is likely to be maintained. The implications of each source of flood risk on access and escape are discussed in detail in the following sections.

4.2.2 Fluvial and tidal

Fluvial risk to the site is considered to be low and unlikely to impede access and escape.

However, the entire site and the surrounding roads are shown to be at tidal risk and inundated during the 0.5% AEP climate change scenarios (design event) in both the defended and undefended scenarios and access and escape will be impeded. Due to the tidal risk surrounding the site, a Flood Warning and Evacuation Plan will be required to be prepared which considers the likely onset and duration of flooding and demonstrates how residents can safely be evacuated and/or shelter safely in situ during design events.

4.2.3 Surface water

Access and escape should be possible via the southeast of the site along the B1016 in the 1% AEP climate change event as there is no surface water risk shown along this road.

Access from the B1016 from the west and Burnaby Road is likely to be impeded as there is significant surface water risk along these roads and along the streets leading to these roads with maximum predicted depths between 0.30m and 0.60m in large areas.

4.3 Dry islands

The site is not located on a dry island.

5 Requirements for drainage control and impact mitigation

5.1 Broadscale assessment of possible SuDS

Surface water at the site should be discharged in accordance with the drainage hierarchy as set out in the National standards for SuDS (gov.uk). SuDS that provide opportunities to deliver multiple benefits including volume control, water quality, amenity, and biodiversity should be prioritised. SuDS proposals should be discussed with relevant stakeholders (Local Planning Authority (LPA), Lead Local Flood Authority (LLFA), and the EA) at an early stage to understand possible constraints.

Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA.

The site is located within the Southchurch Critical Drainage Area. The CDAs currently designated were identified in the Southend-on-Sea SWMP 2015 (southend.gov.uk). It is particularly important that any development within these CDAs will need to demonstrate an adequate surface water drainage system which is maintainable for the lifetime of the development within a site specific FRA. Developers will need to provide details of the long term maintenance of the surface water drainage system. Developers should collaborate with the LLFA to identify all sources of flood risk, help reduce risk to existing communities, and explore grant funding opportunities for these wider improvements. Furthermore, growth allocations should take CDAs into account when assessing site suitability for development, ensuring that flood risk is properly managed and mitigated during planning.

Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site.

The following factors should be considered when assessing whether infiltration is suitable at the site:

- Groundwater levels in the south of the site are indicated to be between 0.5 and 5m below ground level and there is a risk of flooding to subsurface assets and below ground development such as basements. Groundwater monitoring is recommended to determine the seasonal variability of groundwater levels, as this may affect the design of the surface water drainage system.
- However, the majority of the site is not considered to be susceptible to groundwater flooding, due to the nature of the local geological conditions. This should be confirmed through additional site investigation work.
- BGS data indicates that the underlying geology is clay, silt and sand which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site.

- The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality.
- The site encompasses land associated with a former gas works. A thorough ground investigation will be required as part of a detailed site-specific FRA, to determine potential mitigation for contamination and the impact this may have on SuDS. As such, proposed SuDS should be discussed with the relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints.

If it is proposed to discharge runoff to a sewer system, the condition and capacity or the receiving asset should be confirmed through surveys and the discharge rate agreed with the asset owner.

SuDS assets should, where practicable, be located outside areas of flood risk in the 0.5% AEP plus climate change tidal event. As the entire site is shown to be at tidal risk within this event, this presents a significant constraint to the placement and design of sustainable drainage options at this site. SuDS features will need to consider above-ground storage and/or source control and be able to withstand the impacts of tide locking and saltwater ingress. The LLFA should be consulted at an early stage to discuss appropriate drainage options, and the acceptability of SuDS features for the site.

Surface water outfalls that discharge into the Thames Estuary may be susceptible to tide locking due to high water levels. The impacts of tide locking will need to be considered in terms of the attenuation storage requirements of the site and placement of the outfalls.

5.2 Opportunities for wider sustainability benefits and integrated flood risk management

The following are opportunities for wider sustainability benefits and integrated flood risk management at the site:

- It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques.
- Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered.
- The use of multistage SuDS treatment will improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies.

6 NPPF and planning implications

6.1 Exception Test requirements

The Local Planning Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied.

The NPPF classifies mixed-use development as 'More Vulnerable'.

The Exception Test will be required for this site if 'More Vulnerable' development is proposed within Flood Zone 3a.

6.2 Requirements and guidance for site-specific Flood Risk Assessment

At the planning application stage, a site-specific FRA will be required as the proposed development site:

- in Flood Zones 2 and 3a
- at increased risk of flooding from rivers or sea in future
- in an area identified as having critical drainage problems
- at risk of flooding from surface water

All sources of flooding should be considered as part of a site-specific FRA.

Consultation with the LPA, LLFA, Anglian Water, and the EA should be undertaken at an early stage.

Any FRA should be carried out in line with latest guidance including the National Planning Policy Framework (NPPF), Flood Risk and Coastal Change Planning Practice Guidance (PPG), and Southend-on-Sea City Council Local Plan Policies.

The development should be designed with mitigation measures in place where required.

6.3 Guidance for site design and making development safe

The entire site is shown to be at significant tidal flood risk, and mitigation will be required to make development safe at this site, particularly if more vulnerable development is proposed. Further hydraulic modelling of the tidal risk to the site will be required at FRA stage to make sure the development and any associated mitigation measures do not cause off site detriment and assist in the identification of safe access and escape routes and residual risk.

Finished Floor Levels should be raised above the expected height of flooding in line with the EA's guidance and any raising of ground levels should ensure that flood risk is not increased elsewhere. If this is not possible, additional resistance and resilience measures will need to be included as part of the building design to prioritise excluding floodwater where possible and reduce recovery time in the event of water ingress. Resistance measures for flood levels beyond 0.6m can impact on the structural integrity of a building and are unlikely to be suitable.

The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to pre-development greenfield rates, with areas of surface water ponding used as open space and SuDS or water compatible/essential infrastructure uses only. The risk of tide locking will need to be considered within the drainage strategy.

Arrangements for safe access and escape will need to be provided for the 1% AEP fluvial surface events and the 0.5% AEP tidal event with an appropriate allowance for climate change, considering depth, velocity, and hazard. Design and access arrangements will need to incorporate measures, so development and occupants are safe. Given the significant tidal risk on and surrounding the site a Flood Warning and Evacuation Plan will be required to ensure residents can be safely evacuated with sufficient warning and there is sufficient plans for shelter in situ where evacuation is not possible.

Provisions for safe access and escape should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk.

7 Conclusions

Summary of the key areas of flood risk across the site:

- **Tidal**: The site is at significant risk of tidal flooding and is recorded to have previously experienced tidal flooding. The entire site and the surrounding roads are shown to be impacted in the present day undefended events. The site is shown to be protected by tidal defences; however, the entire site is shown to be at risk in the defended 0.5% AEP and 0.1% AEP climate change events which significant depths across the site.
- **Residual**: The site is at residual risk of tidal flooding due to breach or overtopping of the tidal defences. Breach modelling has shown that breaches during the larger flood events provide little to no warning time at the site.
- **Surface water**: There is considerable surface water risk predicted at the site and along the surrounding roads to the north and east in the present day, showing an increase with climate change shown the site. Surface water risk to the surrounding roads is likely to impede potential access and escape options from the north and west of the site.

The following points should be considered in development of this site:

- The Exception Test should be applied if 'More Vulnerable' development is proposed at the site.
- A site-specific FRA should be undertaken, which assess all sources of flood risk. This is likely to require further detailed tidal modelling to demonstrate that the development can be made safe throughout its lifetime and that proposed mitigation measures do not increase flood risk elsewhere.
- Safe access and escape should be considered in the design tidal and surface water events. Developers should demonstrate that safe access and escape routes can be achieved; however, any raising of access and escape routes must make sure that floodwater is not displaced elsewhere. Where safe access and escape is not possible, other means of safe refuge and evacuation must be considered. Due to the tidal risk surrounding the site, a Flood Warning and Evacuation Plan will be required to be prepared which considers the likely onset and duration of flooding and demonstrates how residents can safely be evacuated and/or shelter safely in situ during the design events.
- The tidal defence owner should be consulted at an early stage to determine defence ownership and understand future plans for the defences, including plans for ongoing maintenance or defence improvements.
- Habitable areas of residential ('More Vulnerable') development must be set above the design flood level (0.5% AEP plus a suitable climate change allowance).
- A carefully considered and integrated flood resilient and sustainable drainage design should be put forward, including a site-specific Surface Water Drainage Strategy, and SuDS maintenance and management plan and supported by

detailed modelling. Infiltration testing should be undertaken to confirm the groundwater levels and appropriateness of SuDS, to inform a sustainable drainage strategy in line with the SuDS hierarchy. The tidal risk at the site alongside the risk of tide locking of any outfalls may present a significant constraint to the implementation of SuDS at the site and will require early consultation with the LLFA to identify viable options.

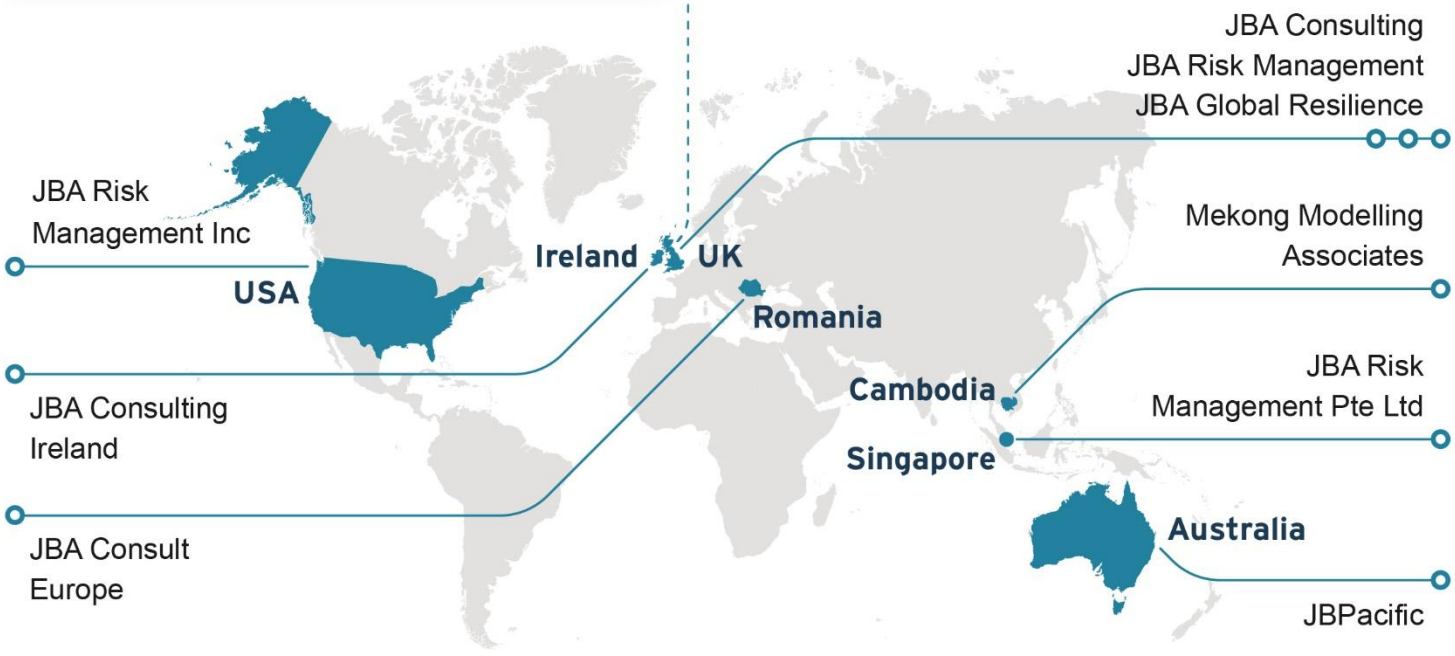
- Anglian Water should be consulted at an early stage on drainage proposals for the site to identify any potential constraints or existing sewer flooding issues that may not have been identified through this high level assessment.

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