Buxton with Lamas Flood Risk Overview

Final

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Contents

Abbreviations

AEP	Annual Exceedance Probability
AOD	Above Ordnance Datum
BGS	British Geological Survey
BwL	Buxton with Lamas
DEFRA	Department for Environment, Food & Rural Affairs
EA	Environment Agency
FRA	Flood Risk Assessment
JBA	Jeremey Benn Associates
LiDAR	Light Detection and Ranging
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
NPPF	National Planning Policy Framework
PPG	Planning Practice Guidance
RoFSW	Risk of Flooding from Surface Water
SuDS	Sustainable Drainage Systems

Definitions

Annual Exceedance Probability (AEP): the probability (expressed as a percentage) of a flood event occurring in any given year.

Climate Change: long term variations in global temperature and weather patterns caused by natural and human actions.

Design flood: This is a flood event of a given annual exceedance probability, as listed below:

- **0.1% AEP:** the probability of an event occurring once in 1000 years, expressed as a percentage.
- **1% AEP:** the probability of an event occurring once in 100 years, expressed as a percentage.
- **3.3% AEP:** the probability of an event occurring once in 30 years, expressed as a percentage.
- **1% AEP plus Climate Change:** the probability of an event occurring once in 100 years, with an appropriate allowance for climate change, expressed as a percentage.

Filtration: The action or process of water infiltrating into soil.

Flood Map for Planning: The EA Flood Map for Planning (Rivers and Sea) is an online mapping portal which shows the Flood Zones in England. The Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences and do not account for the possible impacts of climate change.

Fluvial Flooding: Flooding resulting from water levels exceeding the bank level of a river (main river or ordinary watercourse).

Groundwater emergence: The location at which water from underground flow paths rise to the surface and emerge at ground level.

Groundwater flooding: Flooding occurring when the water table in permeable rock rises and reaches ground level, seeping through to the surface.

Groundwater level: The level, either below ground or above ordnance datum, at which soil or rock is saturated.

Infiltration: The permeation of water into soil by filtration.

Lead Local Flood Authority: the unitary authority for the area or if there is no unitary authority, the county council for the area.

Main river: a watercourse shown as such on the statutory main river map held by the Environment Agency. They are usually the larger rivers and streams. The Environment Agency has permissive powers (not duties) to carry out maintenance and improvement works on main rivers).

Return period: Is an estimate of the interval of time between events of a certain intensity or size, in this instance it refers to flood events. It is a statistical measurement denoting the average recurrence interval over an extended period of time.

Risk: In flood risk management, risk is defined as a product of the probability or likelihood of a flood occurring, and the consequence of the flood.

Sewer flooding: Flooding caused by a blockage or overflowing in a sewer or urban drainage system.

Standard of Protection: Defences are provided to reduce the risk of flooding from a river and within the flood and defence field standards are usually described in terms of a flood event return period. For example, a flood embankment could be described as providing a 1% AEP (1 in 100 year) standard of protection.

Surface water flooding: Also known as pluvial flooding, this is flooding as a result of surface water runoff as a result of high intensity rainfall when water is ponding or flowing over the ground surface before it enters the underground drainage network or watercourse or cannot enter it because the network is full to capacity.

1 Introduction

1.1 Context

JBA have previously produced Level 1 and Level 2 Strategic Flood Risk Assessments (SFRAs) for Greater Norwich to support the development of the Greater Norwich Local Plan. Following this, Buxton with Lamas (BwL) Parish Council requested updated mapping with an accompanying overview of flood risk issues specifically focused within the Parish to support the development of their Neighbourhood Plan.

The report below provides an overview of the sources of flood risk within the Parish, implications of climate change on flood risk, and guidance for developers around options for Sustainable Drainage Systems (SuDS) and site-specific Flood Risk Assessments (FRAs).

The report below should be used in conjunction with the associated interactive GeoPDF mapping to provide a full picture of flood risk across the Parish.

1.2 Study area

1.2.1 Parish overview

The Parish of BwL is located in Norfolk, in the East of England, approximately 12km north of Norwich. Whilst predominantly rural, the main settlements within this Parish include Buxton to the west, Lammas to the east, and a small portion of Badersfield on the eastern border. According to the 2021 census, the population of BwL is approximately 1,642 residents.

The River Bure and Camping Beck flow through the Parish (see Section 2.2), and the Bure Valley Railway bisects the site from north west to south east, between Buxton and Lammas.

1.2.2 Location

BwL is located within the Broadland Rivers Management Catchment in the east of England as shown on the Defra website here. The Broadland catchment is approximately 3,200km^2 and largely rural. The five major main rivers in this catchment drain into the tidally influenced Broads, before flowing out to sea at Great Yarmouth.

1.2.3 Topography

LiDAR data shows that the topography of BwL is extremely low lying and mainly flat. The areas of higher elevation are located along the eastern border, south western corner, and north western corner as shown in the accompanying GeoPDF. The maximum elevation is in the north west of the Parish at approximately 25mAOD. Low-lying areas follow the channels of the River Bure, Stakebridge Beck, and Camping Beck watercourses, the lowest point being downstream of the confluence of Camping Beck and the River Bure at approximately 2.5mAOD.

1.2.4 Geology and soils

Bedrock along the River Bure and Camping Beck are a combination of Lewes Nodular Chalk, Seaford Chalk, Newhaven Chalk, Culver Chalk, and Portsdown Chalk Formations. Bedrock geology elsewhere in the Parish is part of the Crag Group and consists of sand and gravel.

Superficial geology in BwL is highly varied. This includes alluvium, clay, sand, and gravel closest to the watercourses, and glaciogenic formations in the wider Parish.

Along the River Bure and Camping Beck, the soils are loamy and sandy with naturally high groundwater and a peaty surface. Elsewhere in the Parish, the soils are freely draining and slightly acidic and loamy.

2 Sources of flood risk

2.1 Existing drainage features

The primary watercourse in BwL is the River Bure. It flows from the northern border of the Parish southwards towards Lammas and then follows a westerly direction along The Street. It is culverted beneath the road between the urban centres of Buxton and Lammas, and then flows south east to the southern border of BwL. Camping Beck is a tributary of the River Bure which flows west to east through Buxton to the Bure Valley Railway embankment, before flowing south to its confluence with the River Bure to the south east of Buxton. There are also a series of smaller unnamed drainage features that discharge into the River Bure, particularly in the north of the Parish. Finally, a former navigable stretch of Aylsham Navigation runs in a north-south direction between The Street to near the confluence between the River Bure and Camping Beck, to the south east of Buxton.

2.2 Fluvial

2.2.1 Available data

The Environment Agency's (EA) Flood Map for Planning has been used within this assessment for Flood Zones 2 and 3a which incorporates the latest model data from the 2018 River Bure hydraulic model.

Additionally, the 3.3% AEP output from the 2018 River Bure hydraulic model has been used to define Flood Zone 3b (functional floodplain).

There is a small section along Camping Beck within BwL, upstream of Brook Street, which is not included within the model extent of the EA's River Bure model. Where this is the case, Flood Zone 3a should be used as a proxy for Flood Zone 3b, shown as indicative Flood Zone 3b in the accompanying mapping.

2.2.2 Flood characteristics

Flood Zones 2, 3a, and 3b are all channelled by the topography of the River Bure and Camping Beck. Along the northern border of the Parish, the River Bure and Stakebridge Beck present a flood risk to rural land, with Flood Zone 2 extending up to 180m south into the Parish. In this area Flood Zones 2, 3a, and 3b show similar extents.

The flood extent presented by the River Bure is greatest to the north of Lammas, where small drainage features discharge into the Main River. Flood Zone 3b extends up to 375m wide at this location. Some properties in the north of Lammas are shown as lying within Flood Zone 2 and 3a. Further south, the River Bure extent mainly inundates farmland, with Flood Zone 2 extending approximately 170m wide, and Flood Zone 3b extending 130m wide. Between The Street and the Bure Valley Railway line there is a considerable difference in extent between Flood Zones 3b and 3a; Flood Zone 3b is shown to remain confined to the channel whilst Flood Zone 3a extends out of banks particularly on the east side of the channel.

Along Camping Beck, Flood Zone 3b mostly stays in bank other than an area upstream of Brook Street. Flood Zones 2 and 3a also show a greater flood extent upstream of Brook Street, up to 175m wide, although there are no properties within this area. Within Buxton, properties on Bulwer Road, Levishaw Close, Drakes Loke, and Coltishall Road are within Flood Zones 2 and 3a.

2.3 Surface water

2.3.1 Available data

The EA's Risk of Flooding from Surface Water (RoFSW) map has been used within this assessment. This map uses model data to provide areas that are likely to be at surface water flood risk in the 3.3%, 1%, and 0.1% AEP events. These are not areas that have necessarily experienced surface water flooding previously. Local areas known to have been affected by surface water flood risk are discussed in Section 2.7.

2.3.2 Flood characteristics

BwL is only minorly impacted by surface water in the 3.3% AEP event. A series of isolated areas of surface water ponding are shown in spots of lower elevation or along structures such as the Bure Valley Railway. This ponding is shown as having a maximum depth of between 0.6m and 0.9m (although most of the depths remain between 0.15m and 0.3m), a maximum velocity of between 0.25m/s and 0.5m/s and a maximum hazard classification of ‘Danger for Some’.

In the 1% AEP event, surface water is channelled by watercourses such as the River Bure, Camping Beck, and other drainage features that lie at a lower elevation. There are also small surface water flow paths shown to form along highways and roads such as Aylsham Road. This flow path is shown as having a maximum depth of between 0.15m and 0.3m, a maximum velocity of between 1m/s and 2m/s, and a maximum hazard classification of ‘Danger for All’. Similar to the 3.3% AEP event, a series of isolated surface water ponding is shown in areas of lower elevation and along the railway line and highways such as Brook Street to a maximum depth of between 0.6m and 0.9m, a maximum velocity of between 0.25m/s and 0.5m/s, and a maximum hazard classification of ‘Danger for Most’.

In the 0.1% AEP event, the main flow paths throughout BwL show considerable increases in extent, although there are still large rural areas and roads in the wider parish which remain mostly unaffected. Surface water flow paths are routed towards the channels of the River Bure, Camping Beck, and other drainage features that lie at a lower elevation. There is a significant build-up of surface water flooding upstream of Brook Street, with depths exceeding 1.2m, velocities of between 1m/s and 2m/s, and a maximum hazard classification of ‘Danger for All’. Further downstream, surface water is shown to pond behind the Bure Valley Railway embankment, with maximum depths exceeding 1.2m, maximum velocities between 1m/s and 2m/s, and a maximum hazard classification of

‘Danger for All’. North of Lammas, the surface water extents are mostly confined within the channel extent of the River Bure; however, there are wider surface water extents along the smaller unnamed drainage features which extend into the surrounding farmland. Surface water depths across this farmland are shown to be between 0.15m and 0.3m, with velocities of between 0.25m/s and 0.5m/s, and a maximum hazard classification of ‘Danger for Some’. During the 0.1% AEP event, a significant number of properties are at risk of surface water flooding, particularly in Buxton around Camping Beck and to the east of Brook Street.

2.4 Reservoir

According to the EA Reservoir Flood Extents, BwL is not shown as being at risk of reservoir flooding during the ‘Dry Day’ scenario, however, two reservoirs pose a flood risk in the ‘Wet Day’ scenario:

- Elmerdale Farm Reservoir – TG 13600 30500
- Great Water and Saw Mill Pond – TG 22000 34250

The 'Wet Day' event seeks to estimate the effect of a breach at the same time as a 0.1% AEP river flood is occurring and suggests that the consequences of such a breach are similar to the modelled 0.1% AEP event river flood event, but probably would be associated with a much lower probability.

The two reservoirs listed above are not located within BwL, but further north within the Broadland Catchment. Their flood extents are channelled by the lower topography of the River Bure. As such, the northern border of BwL that adjoins the River Bure is shown to be at risk of flooding. Here, the ‘Wet Day’ extent extents up to 132m into the Parish. The extents flow south west and then south east through BwL, channelled by the River Bure. The widest point of the extent is north of Lamas, measuring approximately 410m, with the majority of the flooding on the northern bank. Properties within both Lamas and Buxton are shown as being at flood risk.

2.5 Groundwater

The JBA Groundwater Emergence Map shows the majority of BwL to be at risk from groundwater emergence, with groundwater levels within 0.5m of the surface. Only the parts of the Parish at a higher elevation, such as the eastern border, south western corner, and north western corner are shown as having ‘No risk’ of groundwater emergence. Areas with ‘No risk’ are deemed as having a negligible risk from groundwater flooding due to the nature of the local geological deposits.

Areas with groundwater levels ‘at or very near the surface’ (within 0.025m), are shown along the flow paths of the River Bure, Camping Beck, and Stakebridge Beck. This can extend up to 250m across, particularly along Camping Beck.

Within areas with groundwater levels ‘at or very near the surface’, there is a risk of groundwater flooding to both surface and subsurface assets. Groundwater may emerge at significant rates and has the capacity to flow overland and/or pond within any topographic low spots.

Most of the rest of BwL is shown as having groundwater levels between 0.025m and 0.5m from the surface. This includes the entirety of the Buxton and Lammas village centres. Within these areas there is a risk of groundwater flooding to both surface and subsurface assets. There is also the possibility of groundwater emerging at the surface locally.

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.

2.6 Sewer

Part of the Parish is located in a postcode area NR10 5, with 16 recorded historic sewer flooding incidents, according to available incident records from Anglian Water (covering a ten year period up to November 2023). These incidences were all external flooding predominantly affecting curtilages of properties across Buxton. One incident was recorded in Lamas, affecting an area of agricultural land.

Part of the Parish is located within NR12 7. There have been no recorded sewer events across this area in the last 10 years.

The Parish Council provided anecdotal evidence of known areas of vulnerability along Levishaw Close, where incidences of external sewer flooding are known to occur causing localised flooding of gardens.

2.7 Flood history

The EA's historic flooding and recorded flood outline datasets do not have any record of flooding on or surrounding the Parish.

The Parish Council provided information on known flooding hotspots within the Parish.

Along Camping Beck, Levishaw Close is known to experience flooding as a result of the watercourse overtopping. The water meadows and woods further downstream on the northern side of the watercourse are also known to flood. Downstream of the confluence of Stakebridge Beck and the River Bure, the Bure Valley water meadows along the western side of the watercourse are known to flood. There is a smaller area on the eastern side of the watercourse which is known to experience standing water and pooling. Along the River Bure in the east side of the Parish, the main known flood risk is along the west side of the watercourse. There is a small area along the east side of the watercourse, which is known to become flooded, however, the Bure Valley Railway line acts as a barrier to confine the flood extent to close to the watercourse.

Surface water flooding is reported to frequently affect the main roads into Buxton (Lion Road/Aylsham Road) and several roads within Lammas, including The Street opposite the Piggery, along Hautbois Road, and along Scottow Road.

2.8 Defences

The EA AIMS dataset shows a series of natural high ground and embankments along both banks of the River Bure. This is the case along the whole length of the watercourse throughout the Parish.

2.9 Residual risk

There may be residual risk to BwL if defences such as those mentioned in the section above are breached, or culverts such as that on Mill Street where it crosses the River Bure become blocked.

3 Emergency planning

3.1 Flood warning

Areas either side of the River Bure and Stakebridge Beck, which includes much of the north of Lamas, are located in the River Bure from Brampton to Wroxham EA Flood Warning Area (054WFNF2C).

This area, as well as the immediate floodplain of Camping Beck is located within the River Bure, Spixworth Beck, and surrounding Becks EA Flood Alert Area (054WAFNF2).

3.2 Access and egress

The following sections look at the potential for access and egress to BwL to be affected during fluvial and surface water flooding.

3.2.1 Fluvial flood risk

BwL is bisected by the River Bure. The only existing access between the eastern and western sides of the Parish is via Mill Street which has a bridge over the River Bure. During the fluvial 3.3% AEP and 1% AEP events, access via this highway is likely to be possible; however, during the fluvial 0.1% AEP event, the highway is inundated to depths of up to 0.4m, meaning access and egress is likely to be impeded. Due to the uncertainty of access and egress via Mill Street, it may be beneficial to demonstrate routes into and out of the eastern and western sides of BwL in the fluvial flood events.

During the fluvial 3.3% AEP, 1% AEP, 1% AEP plus 20% climate change, and 0.1% AEP events, access and egress to the eastern side of BwL remains unimpeded along highways such as The Street, Scottow Road, and Hautbois Road. During these same events, access and egress from the western side of BwL is also unimpeded along Cawston Road, Lion Road, Aylsham Road, and Coltishall Road.

3.2.2 Surface water flood risk

During the surface water 3.3% AEP event, access and egress can be demonstrated from all highways within BwL.

During the 1% AEP event, safe access and egress can be demonstrated from most routes; however, travel between the north and south of Buxton via Aylsham Road/Coltishall Road may be impeded. There is a surface water flow path along Aylsham Road between Stracey Road and Drakes Loke with maximum depths between 0.15m and 0.3m and a maximum hazard classification of 'Danger for some' although the hazard mostly remains as 'Very Low Hazard' suggesting emergency access and egress may still be possible. Those in the north of the Parish are likely to still be able to travel north on Aylsham Road out of the area, and those in the south can travel south via Coltishall Road. Highways such as The Street, Scottow Road, and Lion Road experience minor surface water ponding but this is unlikely to affect access and egress.

Depth, hazard, and velocity data is unavailable for the 1% AEP plus 40% climate change event. As such, the 0.1% AEP data can be used as a proxy approach; however, more detailed surface water modelling may be required during a site specific FRA.

During the 0.1% AEP surface water event, Aylsham Road is shown to be inundated to depths of up to 0.6m around Camping Beck, meaning travel between the northern and southern parts of the town is likely to be impeded. As such, access and egress should be found in the same way as in the 1% AEP event. There is surface water ponding along highways such as The Street, Scottow Road, and Lion Road; however, none of these areas are shown to exceed 0.3m, and therefore access and egress by emergency vehicles is likely to still be possible. Brook Street on the other hand, is not shown as being likely to be a viable access and egress route, as surface water inundates this to depths of up to 0.6m where it crosses Camping Beck.

4 Climate change

Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding.

4.1 Fluvial

The 1% AEP plus 20% climate change event for the River Bure hydraulic model was used in this assessment and can be compared with the 1% AEP event to assess the potential implications of climate change on fluvial flood risk.

The impact of climate change is shown to be minimal along the River Bure upstream of The Street. The increase in depth and extent in this area is negligible, with the most extreme increases around the small unnamed drainage features north of Lammas where depths increase from 0.18m to 0.24m. This is also the case downstream of the confluence between the River Bure and Camping Beck. No additional flow paths are created during the climate change scenario, and no additional properties are shown within the flood extent.

Between The Street and the confluence of the River Bure and Camping Beck, the impact of climate change is greater with additional flow paths shown near to the Bure Valley Railway and Aylsham Navigation. The flow path west of the River Bure extends north by up to 160m and has a maximum depth of around 0.85m. Furthermore, there is an increased number of properties within the climate change flood extent, particularly off Mill Street.

Camping Beck is shown as being susceptible to climate change, particularly downstream of Brook Street. The flood extents increase by up to 40m to the north and are shown as inundating additional residential areas. Depths in some areas increase from 0.19m in the 1% AEP event to 0.26m in the 1% AEP plus 20% climate change event.

4.2 Surface water

The 1% AEP plus 40% climate change event was available for this assessment and can be compared with the 1% AEP extent to assess the potential implications of climate change on surface water flood risk.

In the surface water climate change event, surface water is channelled by the River Bure, Camping Beck, and other drainage features that lie at a lower elevation; however, the flood extents are shown to be considerably wider in places than in the 1% AEP event. This includes upstream of Brook Street where flood extents increase by between 10m and 60m between the 1% AEP and 1% AEP plus 40% climate change events, ponding along the Bure Valley Railway embankment where extents increase by up to 28m, and in the agricultural land north of Lamas where extents increase by 2m to 46m in places. BwL is shown as being susceptible to climate change in the events described above particularly along Camping Beck.

5 Requirements for drainage control and impact mitigation

5.1 Broad-scale assessment of possible SuDS for development sites

Groundwater levels are indicated to be between 0.025m and 0.5m of the surface across the majority of the Parish; however, land along the flow paths of the River Bure, Camping Beck, and Stakebridge Beck experience groundwater levels at or very near the surface (within 0.025m of ground level). As such, there is a risk of groundwater flooding at the surface during a 1% AEP event, which may flow to and pool within topographic low spots. Detention and attenuation features should be designed to prevent groundwater ingress from impacting hydraulic capacity and structural integrity. Additional site investigation work may be required to support the detailed design of drainage systems. This may include groundwater monitoring to demonstrate that a sufficient unsaturated zone has been provided above the highest occurring groundwater level. Below ground development such as basements are not likely to be appropriate across most areas of BwL.

BGS data indicates that the underlying geology is a mixture of chalk, sand, and gravel and therefore is likely to have 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.

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

5.2 Wider sustainability benefits and integrated flood risk management

The following should be considered to provide wider sustainability benefits and integrated flood risk management at development sites:

- Implementation of SuDS could provide opportunities to deliver multiple benefits including volume control, water quality, amenity, and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders including Broadland District Council as the Local Planning Authority (LPA), Norfolk County Council as the Lead Local Flood Authority (LLFA), and the EA at an early stage to understand possible constraints.
- Development should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development.
- Opportunities to incorporate filtration techniques such as filter strips, filter drains, and bioretention areas must be considered. Filtration techniques focus on removing pollutants and contaminants from surface water runoff before it is discharged from a site (either into the ground, water bodies or sewer). The

filtration media within these systems (such as soil, sand, or specialized filter media) help to trap pollutants and remove them from the water. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. 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.

- There are no Groundwater Source Protection Zones within BwL, and there are no restrictions over the use of infiltration techniques with regard to groundwater quality. These techniques typically involve the use of permeable surfaces, such as pervious pavements, gravel trenches, or infiltration basins, which allow water to seep into the soil below.
- There is one historic landfill site located in the south of BwL, along Coltishall Road to the north of the Mayton Woods recycling centre. If any sites are proposed within the historic landfill site 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.
- Proposed attenuation features such as basins, ponds, and tanks should be located outside of areas in Flood Zone 3 to avoid the potential risks to the hydraulic capacity or structural integrity of these features.
- Surface water discharge rates should not exceed existing greenfield runoff rates. Opportunities to further reduce discharge rates should be considered and agreed with the LLFA. 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.
- The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths through BwL during the 1% AEP and 0.1% AEP events. This includes flow paths channelled by the River Bure and Camping Beck, as well as significant surface water ponding in areas of low elevation and against structures such as the Bure Valley Railway. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space.
- Opportunities to incorporate source control techniques such as green roofs, permeable surfaces, and rainwater harvesting must be considered during the site design stage.
- Opportunities for integrated water management and use of rainwater harvesting measures for non-potable uses such as irrigation and flushing toilets in a domestic setting. This has the additional benefit of reducing potable water use, improving the sustainability of new developments.
- The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access such as that west of Brook Street and west of the Bure Valley Railway.

- Where slopes are >5%, features of any implemented conveyance features should follow contours or utilise check dams to slow flows down the slope.

6 NPPF and planning implications

6.1 Exception Test requirements

For any developments within BwL, the LPA 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.

If required, the exception test may be required for the development. The exception test is required if:

- 'More Vulnerable' and 'Essential Infrastructure' development is located within Flood Zone 3a.
- 'Highly Vulnerable' development is located within Flood Zone 2.
- The site is located in an area at high risk of surface water flooding and cannot be developed around.
- 'Highly Vulnerable' infrastructure should not be permitted within Flood Zone 3a and Flood Zone 3b.
- 'More Vulnerable' and 'Less Vulnerable' infrastructure should not be permitted within Flood Zone 3b.

6.2 Site-specific Flood Risk Assessments

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

- Within Flood Zones 2, 3 or 3b,
- Within Flood Zone 1 with a site area of 1 hectare or more,
- Within areas with critical drainage problems,
- Within Flood Zone 1 where the SFRA shows it will be at risk of flooding from rivers in the future,
- Increasing in vulnerability classification (e.g. changing from commercial to residential), or
- Is in Flood Zone 1 where the SFRA shows it is at risk from other sources of flooding or will be during its lifetime.

All sources of flooding should be considered as part of a site-specific FRA. Consultation with the LPA, LLFA, Water Company, and the EA should be undertaken at an early stage.

Any FRA should be carried out in line with the National Planning Policy Framework (NPPF); Flood Risk and Coastal Change Planning Practice Guidance (PPG); Norfolk County Council's Local Plan available here, and Norfolk County Council's SuDS Strategy available here.

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

6.3 Site design and making development safe

The following points should be considered in site design and making development safe from flood risk:

- The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG).
- 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 ephemeral 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.
- Arrangements for safe access and egress will need to be provided for the 1% AEP fluvial and surface water events 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.
- Provisions for safe access and egress 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.
- Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels and use of boundary walls. These measures should be assessed to make sure that flooding is not increased elsewhere.

7 Conclusions and recommendations

7.1 Summary of flood risk

Fluvial: the primary sources of flood risk are the River Bure and Camping Beck, as well as any associated unnamed tributaries. The River Bure bisects the Parish, flowing between the urban centres of Buxton and Lamas and poses flood risk to properties in both villages. Camping Beck flows west to east through Buxton to its confluence with the River Bure and poses potential flood risk to numerous properties in Buxton.

Surface water: BwL is shown to be at risk of surface water flooding in the 1% AEP and 0.1% AEP events. The main areas of risk are along the low-lying elevations of the River Bure and Camping Beck, as well as highways and the Bure Valley Railway.

Climate change: Areas at risk of flooding today are likely to become at increased risk in the future and the frequency of flooding will also increase in such areas, due to climate change. Areas that are most susceptible to climate change are those central to the Parish between Buxton and Lammas, and in Buxton close to Camping Beck.

Sewer: Anglian Water provide water services and sewerage services across the study area and have provided details of 16 historic sewer flooding across the study area.

Groundwater: the JBA Groundwater Emergence Map shows that the majority of the Parish has groundwater levels between 0.025m and 0.5m from the surface. Land immediately adjacent to the River Bure and Camping Beck have groundwater levels within 0.025m of the surface.

Reservoirs: there are no reservoir extents impacting the Parish in the ‘Dry Day’ scenario. There are two reservoirs inundating BwL in the ‘Wet Day’ scenario. The reservoir extents are channelled by the River Bure. The level and standard of inspection and maintenance required under the Reservoirs Act means that the risk of flooding from reservoirs is relatively low. However, there is a residual risk of a reservoir breach, and this risk should be considered in any site-specific FRAs (where relevant).

Defences: the EA AIMS dataset shows a series of natural high ground and embankments along both banks of the River Bure.

7.2 Recommendations for development and flood risk

The risk of flooding should be reviewed as early as possible in the development process to ensure that opportunities are taken to reduce the risk of flooding on and off the site. Where necessary, development and redevelopment within the study area will require a flood risk assessment (FRA) appropriate to the scale of the development and to the scope as agreed with Norfolk County Council as LLFA and/or EA. FRAs should consider flood risk from all sources including residual risk, along with promotion of Sustainable Drainage Systems (SuDS) to create a conceptual drainage strategy and safe access/egress at the development in the event of a flood. Latest climate change guidance (last updated in May 2022) should also be taken into account, for the lifetime of developments. Planners and developers must check that modelling in line with the most up to date EA climate change guidance has been run.

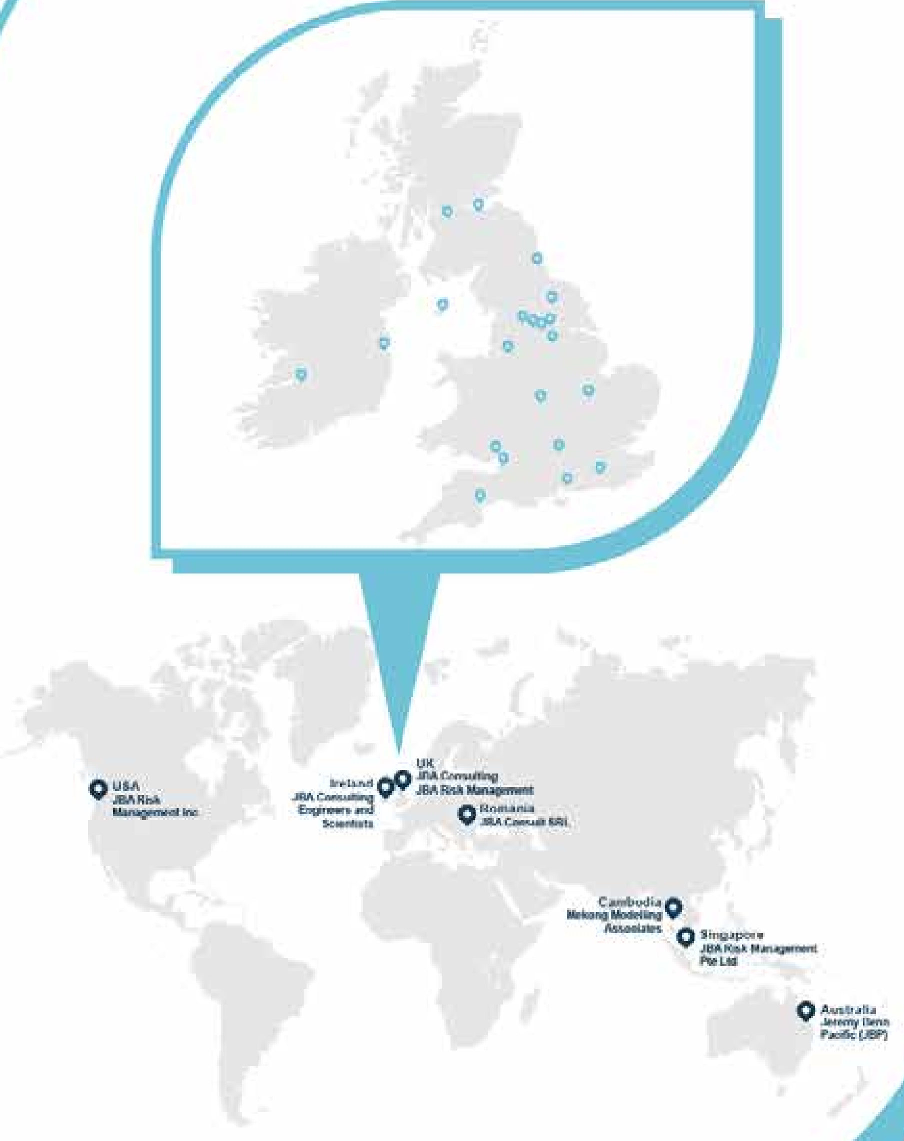
8 Data sources

Table 8-1 below details the data that has been used to inform this flood risk overview and the accompanying mapping for BwL.

Table 8-1: Data sources used in this assessment.

Data	Source and additional information
Buxton with Lamas Parish	The boundary of the Buxton with Lamas Parish, the study area for this SFRA. Provided by Buxton with Lamas Parish Council.
Watercourses	Main Rivers - the EA statutory main rivers map detailing the watercourses which are designated a Main River by the EA.
Flood Zones (actual risk)	The Flood Zones are for use in development planning and flood risk assessments: Flood Zone 3b – Functional Floodplain: This zone comprises land where water must flow or be stored in times of flood. Identified as land which would flood with greater than a 3.3% change in any year. Flood Zone 3a – High probability: greater or equal to a 1% chance of river flooding in any given year (Excludes Flood Zone 3b, which is derived as part of the SFRA). Flood Zone 2 – Medium probability: between a 1% and 0.1% chance of river flooding in any given year. Flood Zones 2, 3a and 3b have been taken from the EA's River Bure detailed hydraulic model (2018). Indicative Flood Zone 3b in the accompanying mapping shows the same extent as Flood Zone 3a and should be used where detailed modelling of the 3.3% AEP event is not available in the upstream reach of Camping Beck.
Fluvial Climate change	The 1% AEP plus 20% climate change allowance for the EA's River Bure detailed hydraulic model (2018) has been used for this study.
Fluvial depth, velocity, and hazard mapping	Depth, velocity, and hazard data was derived from the EA's River Bure detailed hydraulic model (2018).
Surface water	The RoFSW map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity, and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from EA's RoFSW.
Surface water climate change	The RoFSW has previously been uplifted to represent surface water climate change for the 1% AEP plus 40% climate change event. Only extent data was available for this event.
Sewer flooding	DG5 sewer flood event data was provided by Anglian Water for the last 10 years (up to November 2023). This provides the type and location of sewer flooding incidences. To protect individual properties being identifiable, this data has not been included in the accompanying mapping.
Risk of	JBA's Groundwater Emergence Map shows the level of groundwater

Data	Source and additional information
groundwater flooding	below the surface, at a resolution of 5m. Flood risk could increase when groundwater is already high or emerged, causing additional overland flow paths or areas of still ponding, which may occur at sites other than those shown in the emergence mapping.
Risk of flooding from reservoirs	The EA reservoir flood extents show the predicted flooding which would occur if a dam or reservoir fails. The EA provide two scenarios: Dry Day – the predicted flooding which would occur if the dam or reservoir fails when rivers are at normal levels. Wet Day – the predicted worsening of the flooding which would be expected if a river is already experiencing an extreme natural flood.
Defences	The EA Asset Information Management System (AIMS) spatial Flood Defence dataset, shows flood defences currently owned, managed, or inspected by the EA. A defence is any asset that provides flood defence or coastal protection functions.
Flood mitigation	The EA issue flood warnings to designated Flood Warning Areas when a river level hits a certain threshold, heavy rainfall or high tides and strong winds are forecast. "Flooding is expected, immediate action is required". Flood Alerts are issued when there is water out of bank for the first time anywhere in the catchment and when forecasts indicate flooding may be possible. "Flooding is possible, be prepared". Both datasets are a polygon GIS shapefile where the above are issued; they are not flood extents.
Flood history	The EA Historic Flood Map shows areas of land that have been previously subject to fluvial flooding in the area. This includes flooding from rivers, the sea and groundwater springs but excludes surface water. If an area is not covered by the Historic Flood Map, it does not mean that it has never flooded, only that currently there are no records of flooding in this area from the EA records. The Parish Council also provided information on known flooding hotspots within the Parish.



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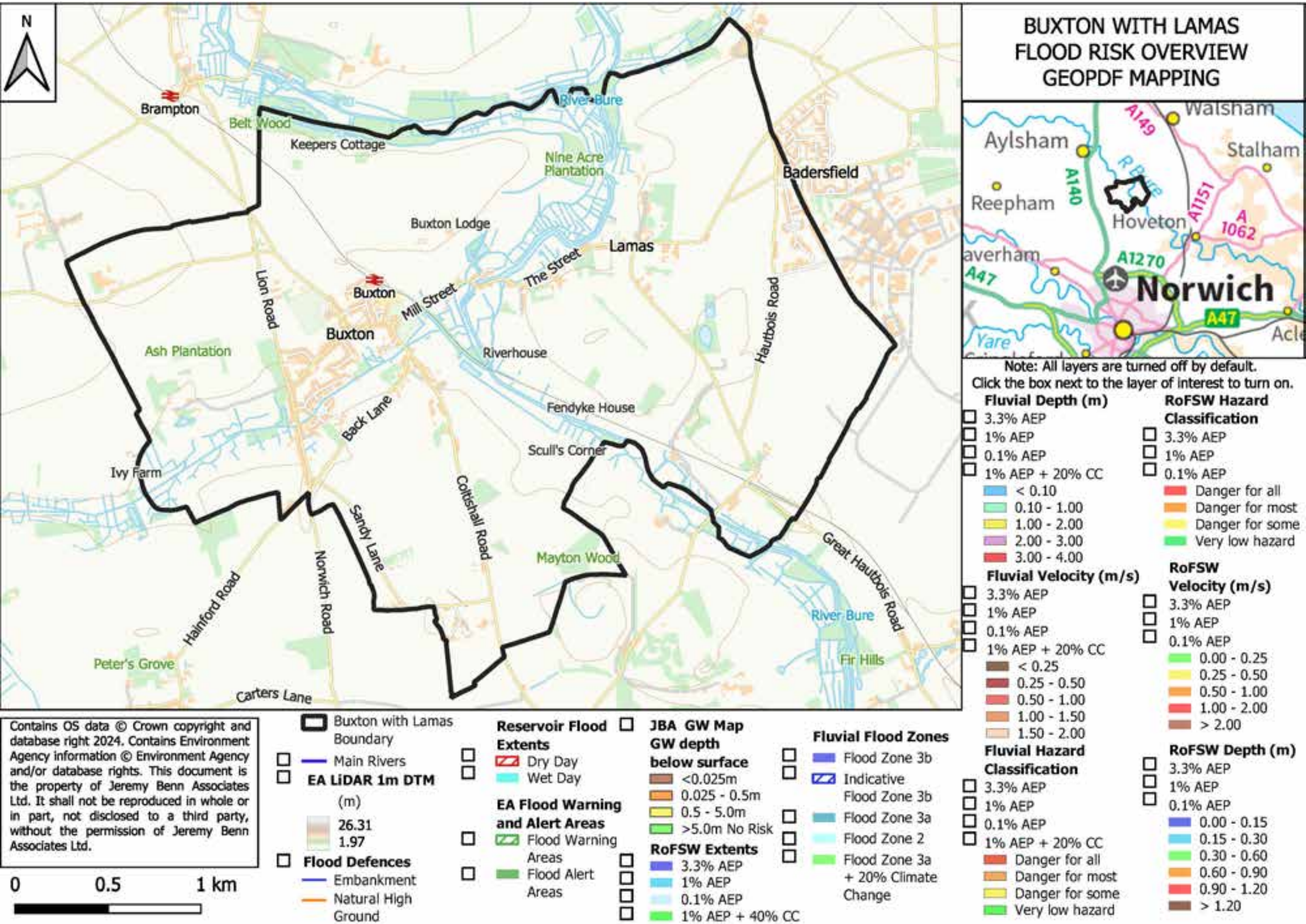
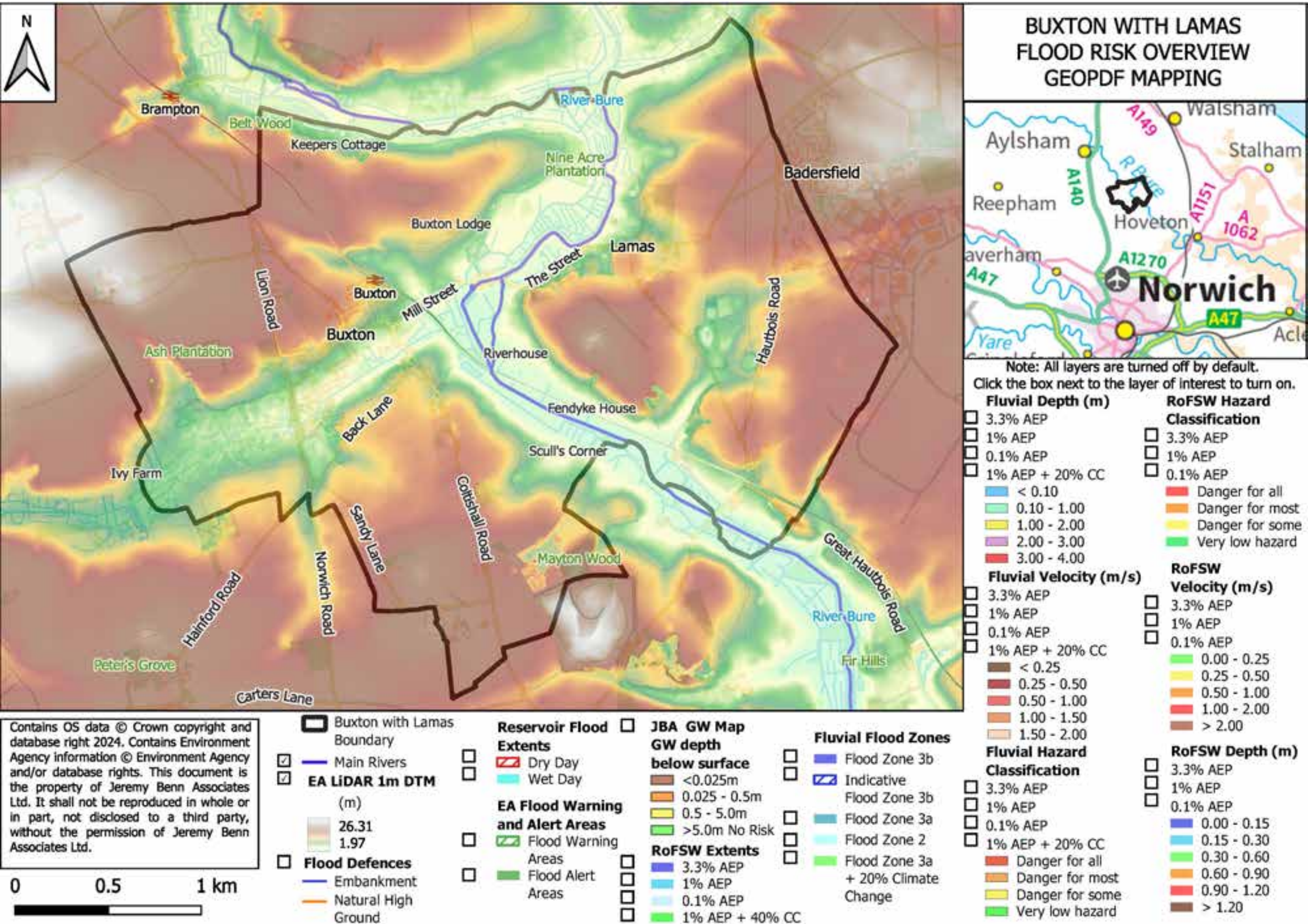
JBA Flood Maps

Interactive Map Layers

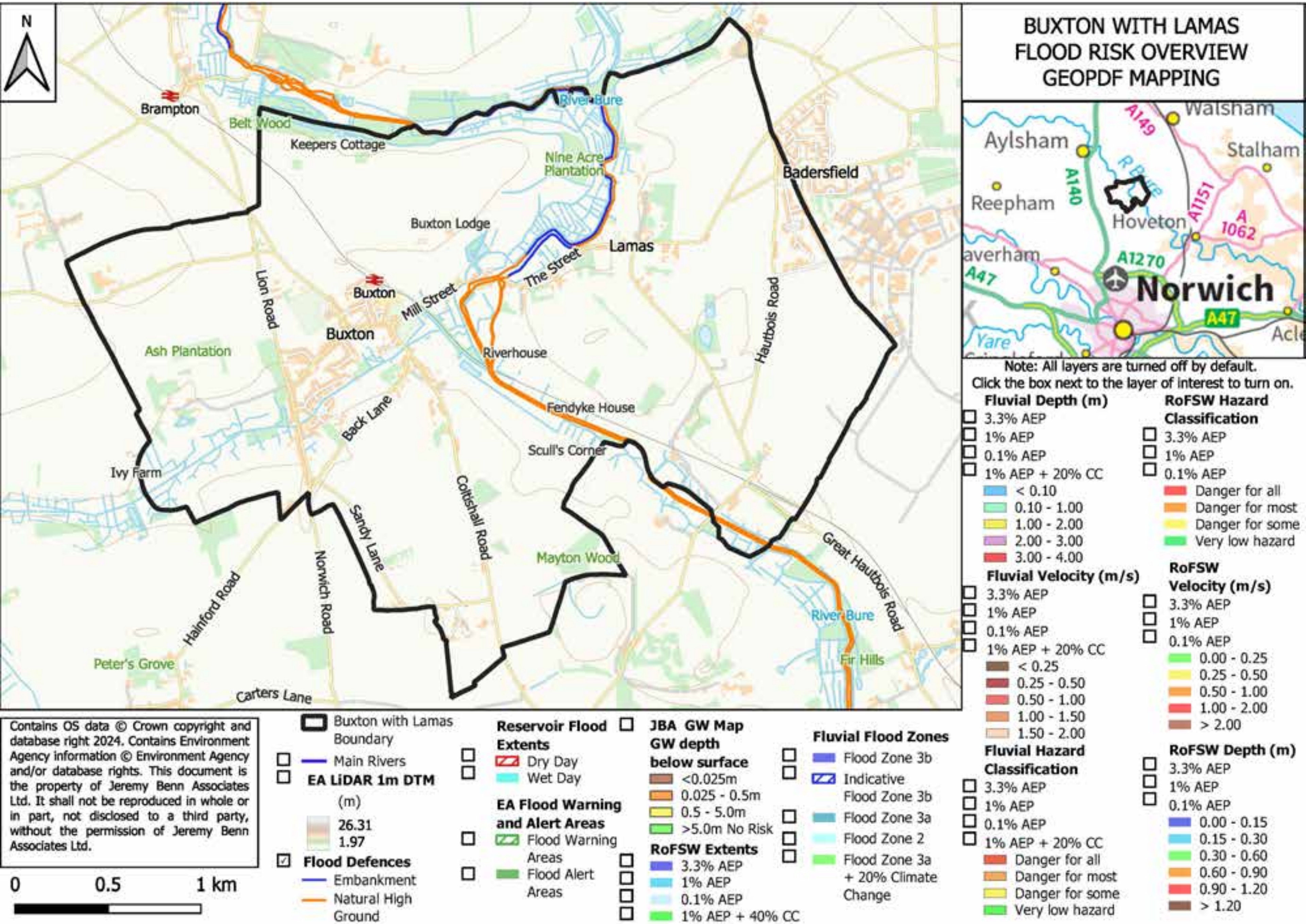
Baseline map of our parish. Click on the boxes you want to see.



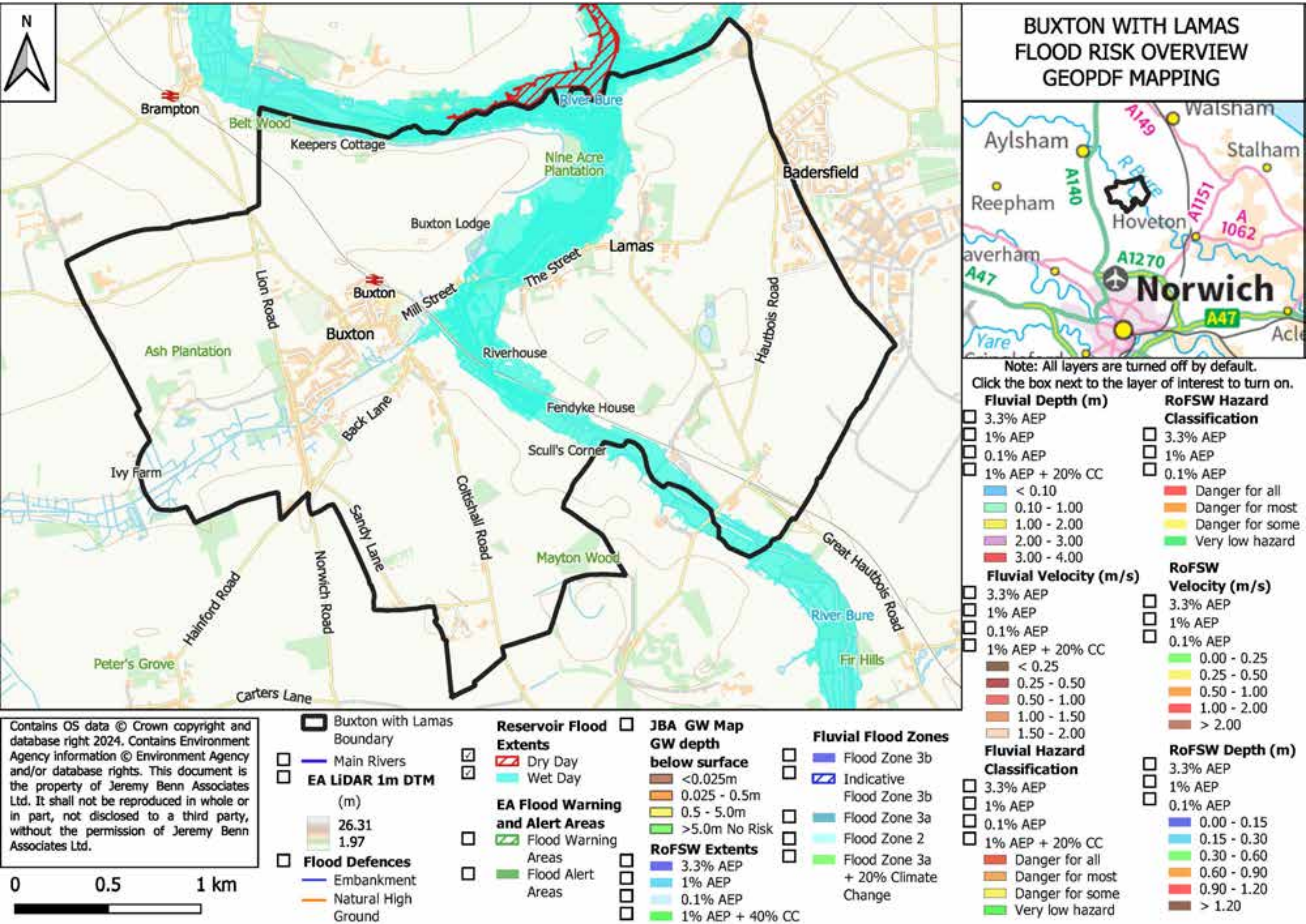
EA LIDAR 1m DTM: This shows the topographical contours, or hills and valleys.



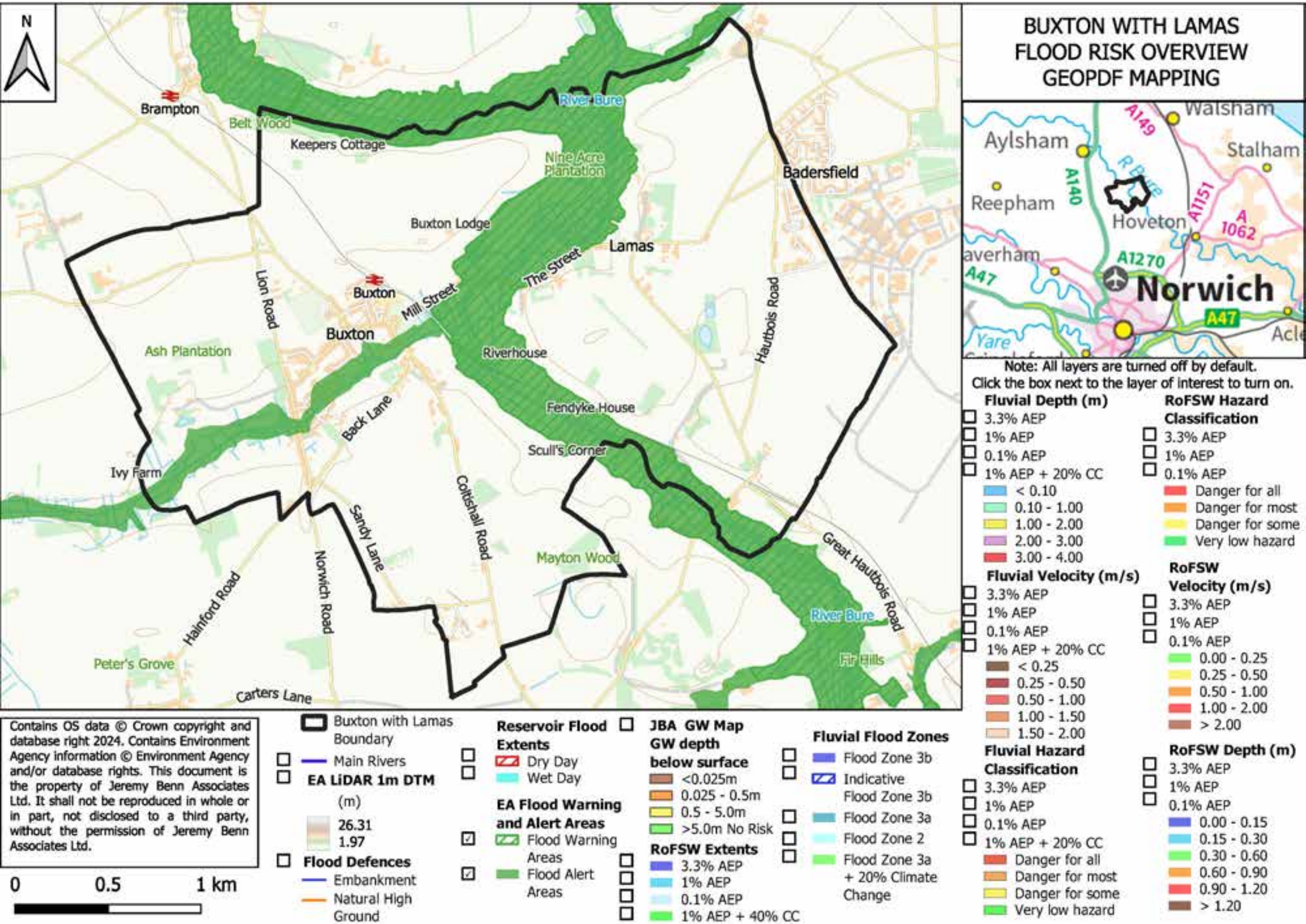
Flood Defences: This shows us where there are naturally high banks along the river.



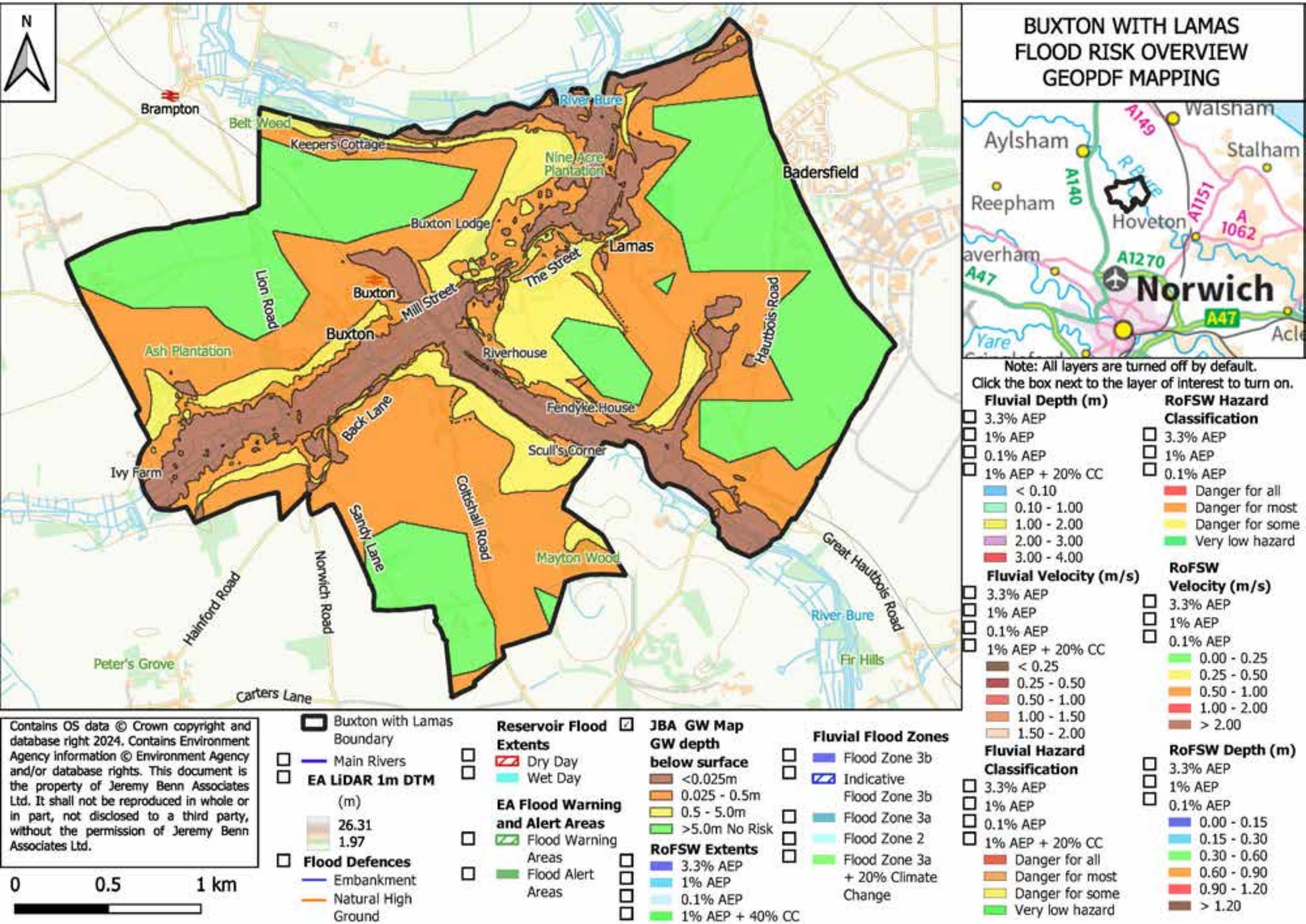
Reservoir Flood Extents: The extent of a flood from reservoirs on a dry day and a wet day.



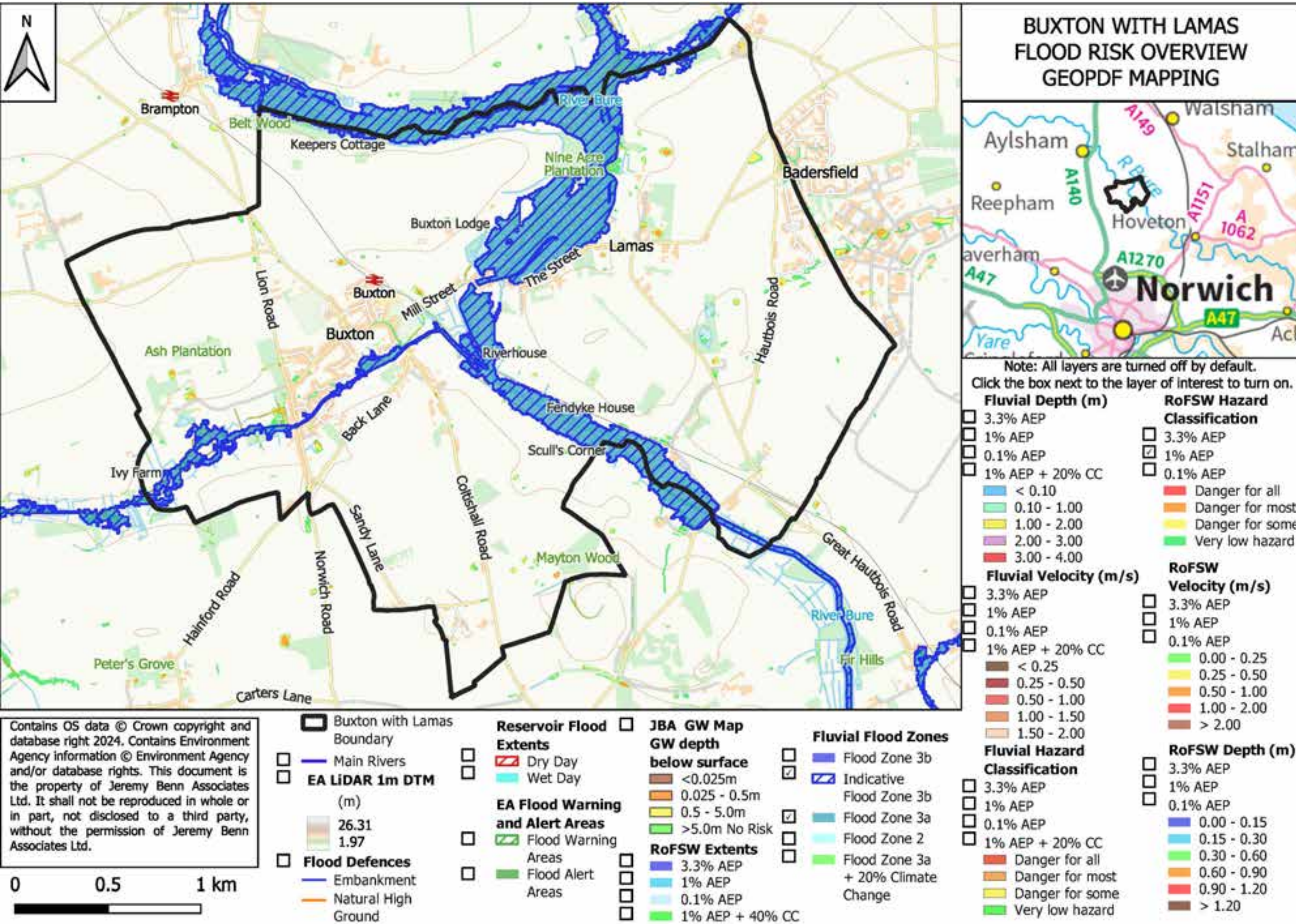
EA Flood Warning and Alert Areas: Environmental Agency warning and alert areas.



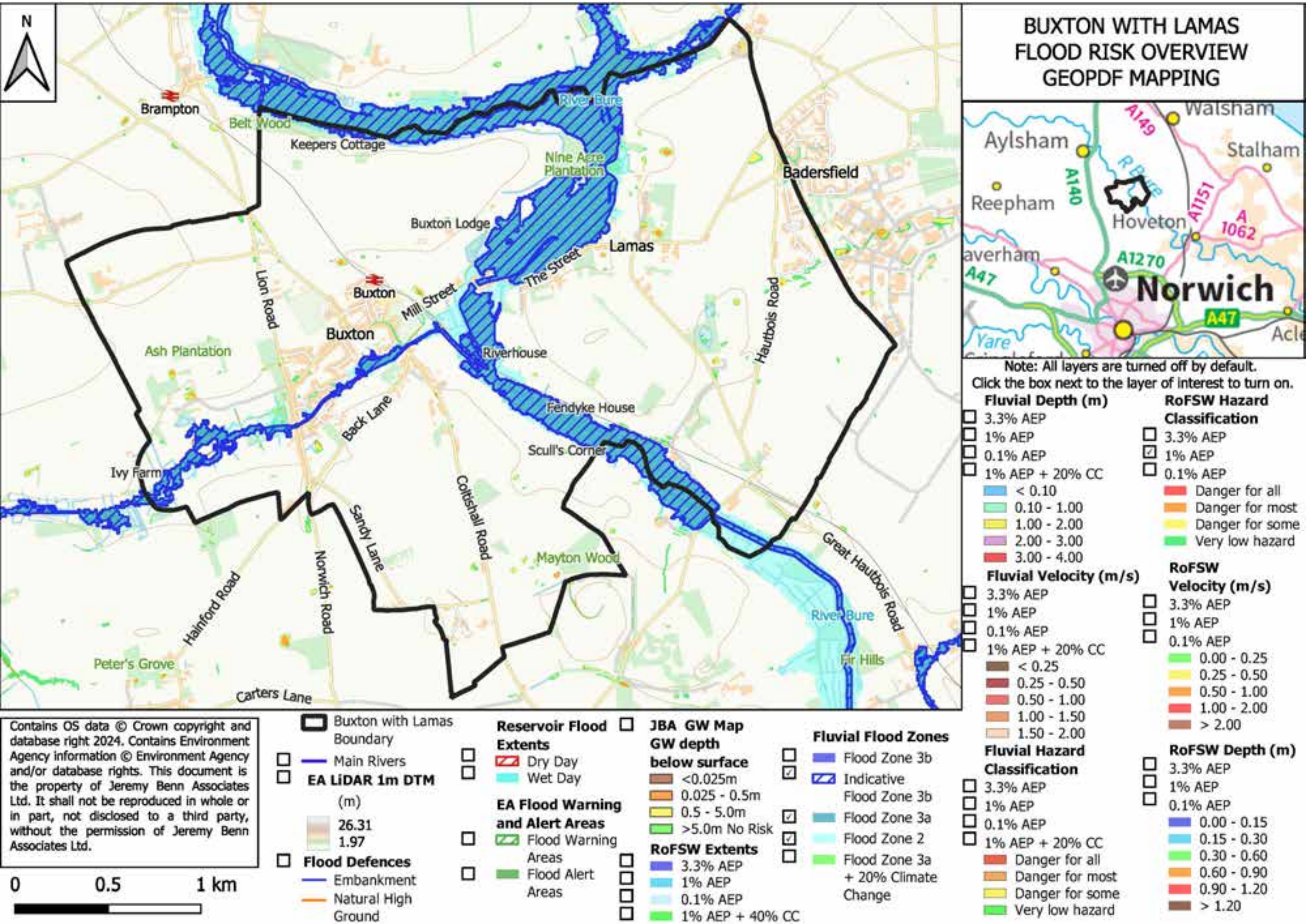
JBA Groundwater Flood Map: This shows the depth of the groundwater below the soil surface.



Fluvial Flood Zones: Flood Zones 3b, and 3a.

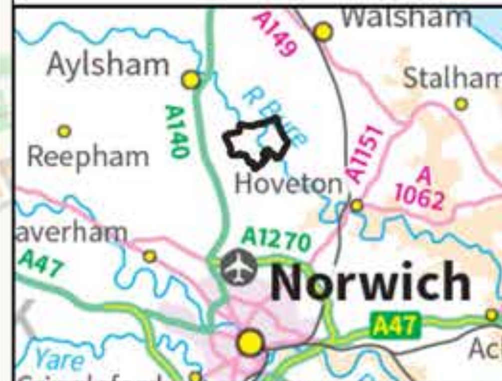


Fluvial Flood Zones: Flood Zones 3b, 3a and 2 (hashed zone is 3a so you can see its overlapping).



Fluvial Flood Zones: Flood Zones 3b, 3a and 2 with climate change.

BUXTON WITH LAMAS
FLOOD RISK OVERVIEW
GEOPDF MAPPING



Note: All layers are turned off by default.
Click the box next to the layer of interest to turn on.

Fluvial Depth (m)
- ☐ 3.3% AEP
- ☐ 1% AEP
- ☐ 0.1% AEP
- ☐ 1% AEP + 20% CC
- < 0.10
- 0.10 - 1.00
- 1.00 - 2.00
- 2.00 - 3.00
- 3.00 - 4.00

RoFSW Hazard Classification
- ☐ 3.3% AEP
- ☐ 1% AEP
- ☐ 0.1% AEP
- Danger for all
- Danger for most
- Danger for some
- Very low hazard

Fluvial Velocity (m/s)
- ☐ 3.3% AEP
- ☐ 1% AEP
- ☐ 0.1% AEP
- ☐ 1% AEP + 20% CC
- < 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00

RoFSW Velocity (m/s)
- ☐ 3.3% AEP
- ☐ 1% AEP
- ☐ 0.1% AEP
- 0.00 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- > 2.00

Fluvial Hazard Classification
- ☐ 3.3% AEP
- ☐ 1% AEP
- ☐ 0.1% AEP
- ☐ 1% AEP + 20% CC
- Danger for all
- Danger for most
- Danger for some
- Very low hazard

RoFSW Depth (m)
- ☐ 3.3% AEP
- ☐ 1% AEP
- ☐ 0.1% AEP
- 0.00 - 0.15
- 0.15 - 0.30
- 0.30 - 0.60
- 0.60 - 0.90
- 0.90 - 1.20
- > 1.20

0 0.5 1 km

- Buxton with Lamas Boundary
- ☐ Main Rivers
- ☐ EA LiDAR 1m DTM (m)
  - 26.31
  - 1.97
- ☐ **Flood Defences**
  - Embankment
  - Natural High Ground

Reservoir Flood Extents
- ☐ Dry Day
- ☐ Wet Day

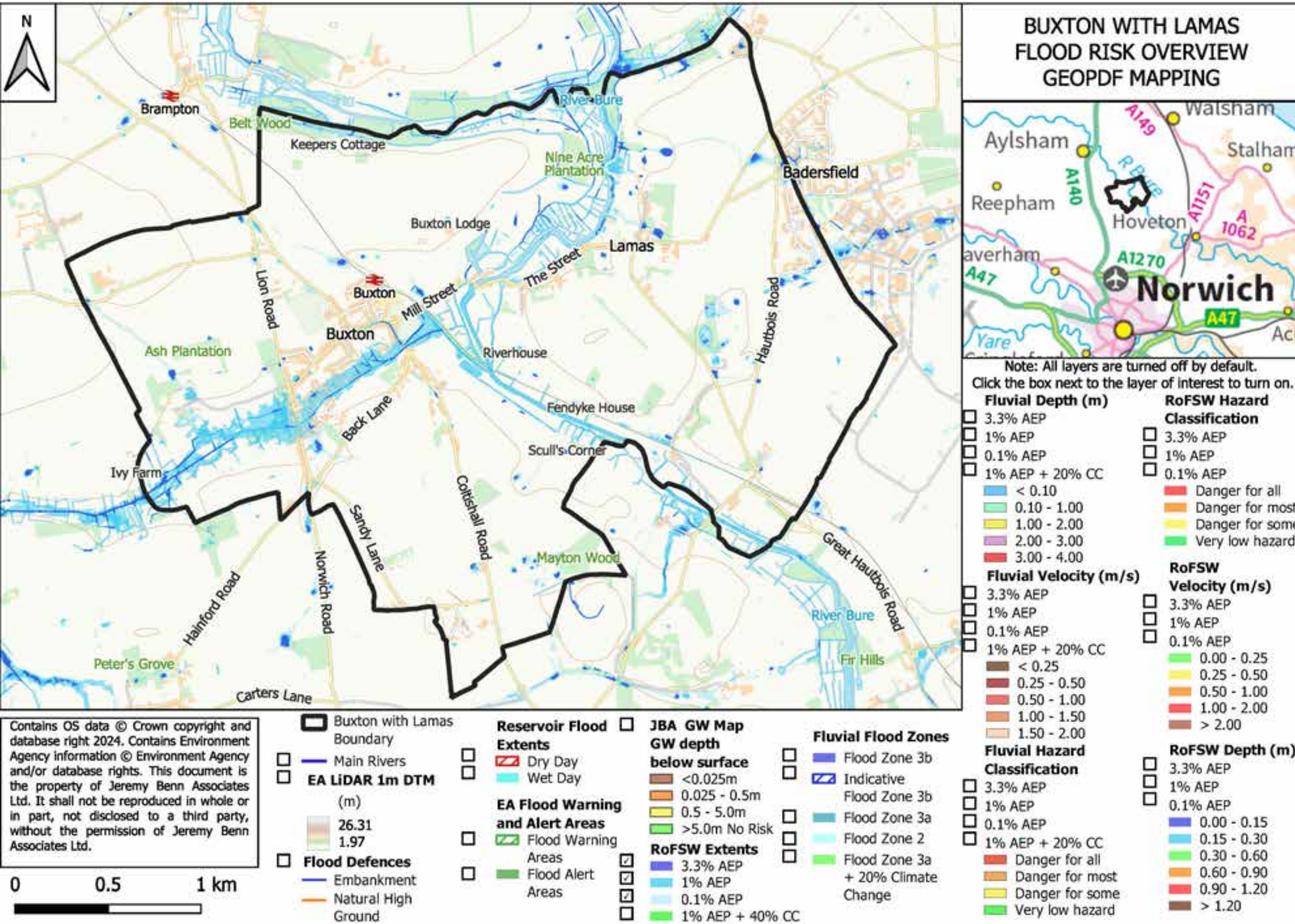
EA Flood Warning and Alert Areas
- ☐ Flood Warning Areas
- ☐ Flood Alert Areas

☐ **JBA GW Map GW depth below surface**
- <0.025m
- 0.025 - 0.5m
- 0.5 - 5.0m
- >5.0m No Risk

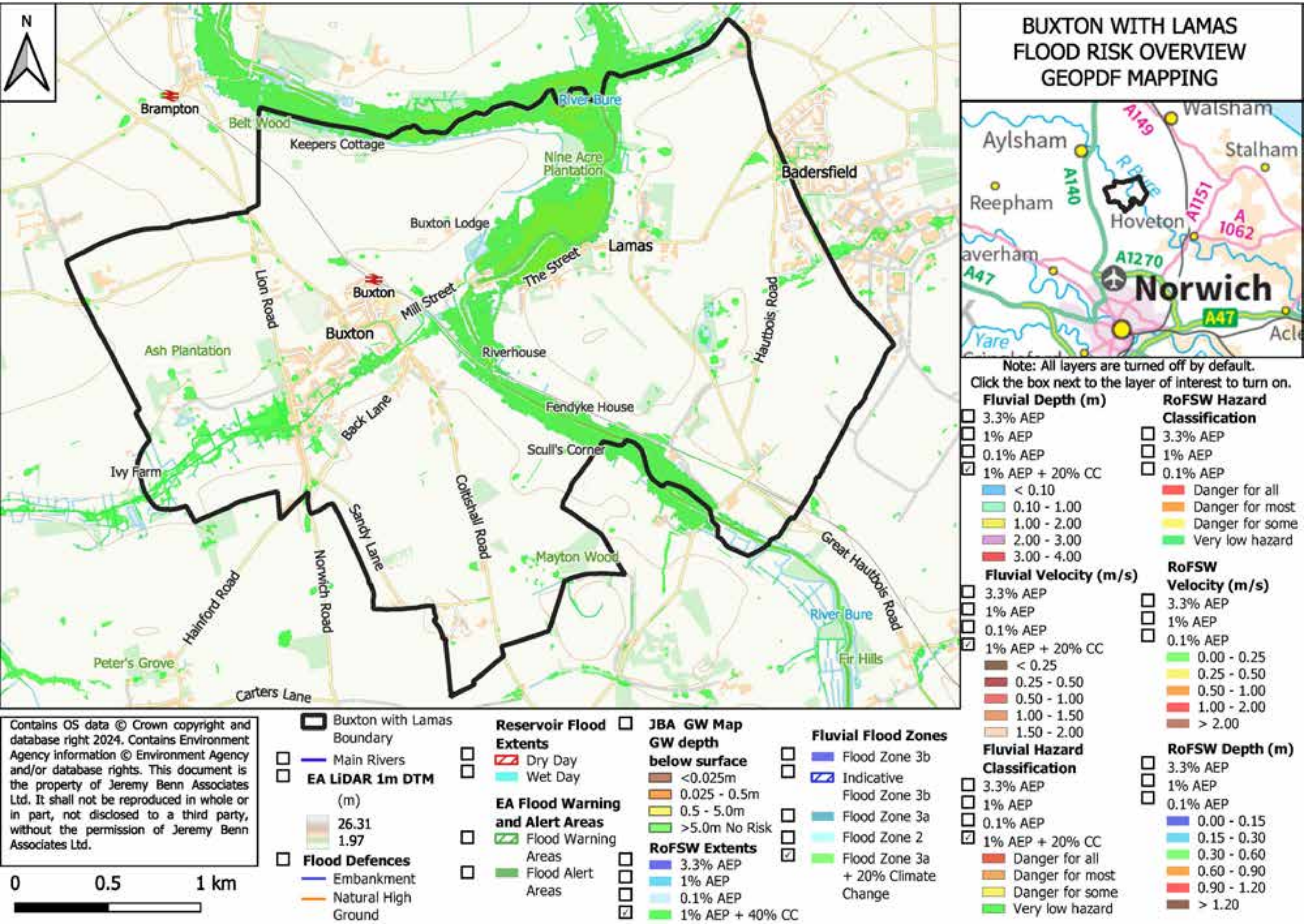
RoFSW Extents
- ☐ 3.3% AEP
- ☐ 1% AEP
- ☐ 0.1% AEP
- ☐ 1% AEP + 40% CC

Fluvial Flood Zones
- ☑ Flood Zone 3b
- ☐ Indicative Flood Zone 3b
- ☐ Flood Zone 3a
- ☑ Flood Zone 2
- ☑ Flood Zone 3a + 20% Climate Change

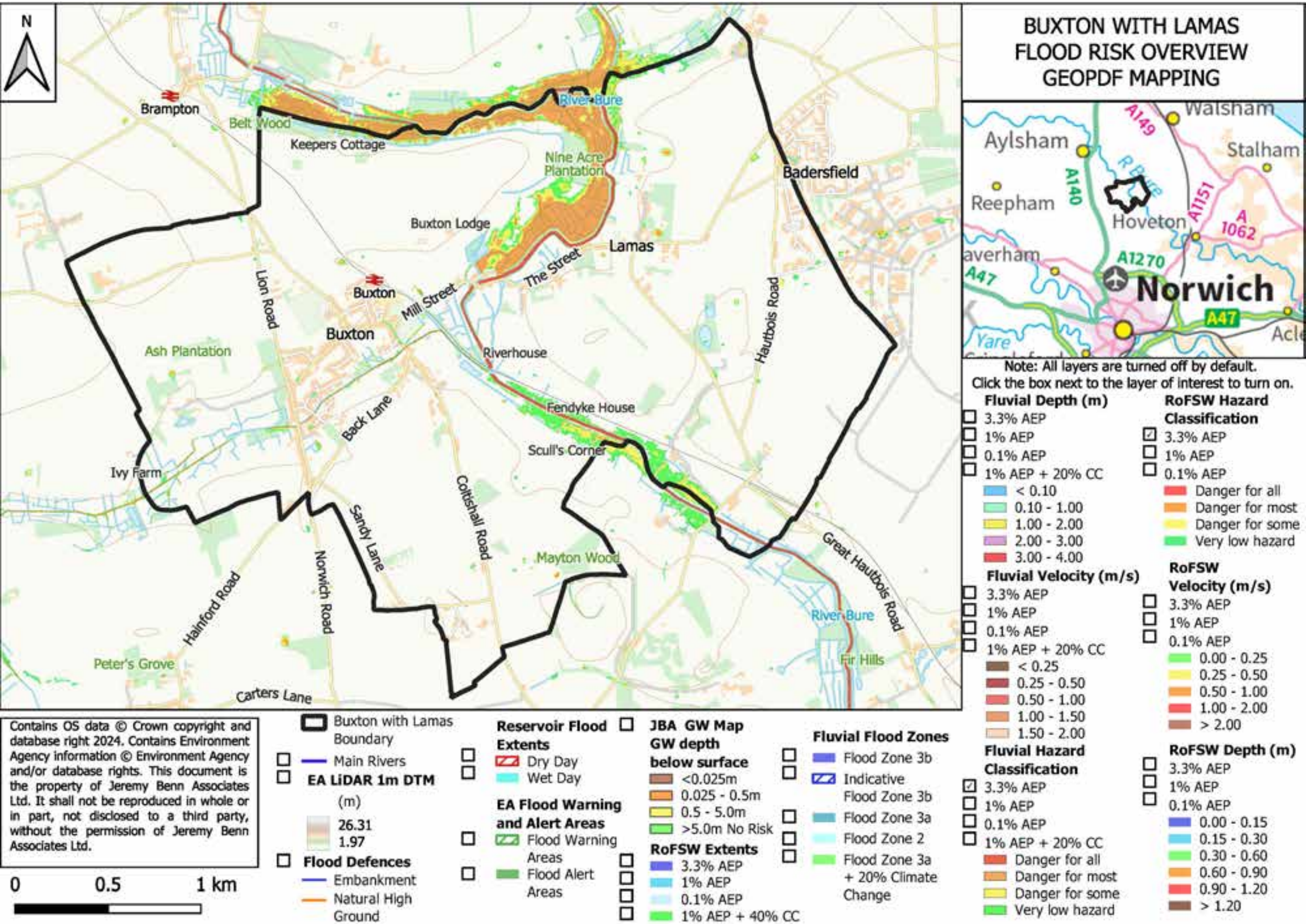
Risk of Flood Surface Water (RoFSW) Extent: 1 in 33 years (3.3%), 1 in 100 years (1%) and 1 in 1000 years (0.1%).



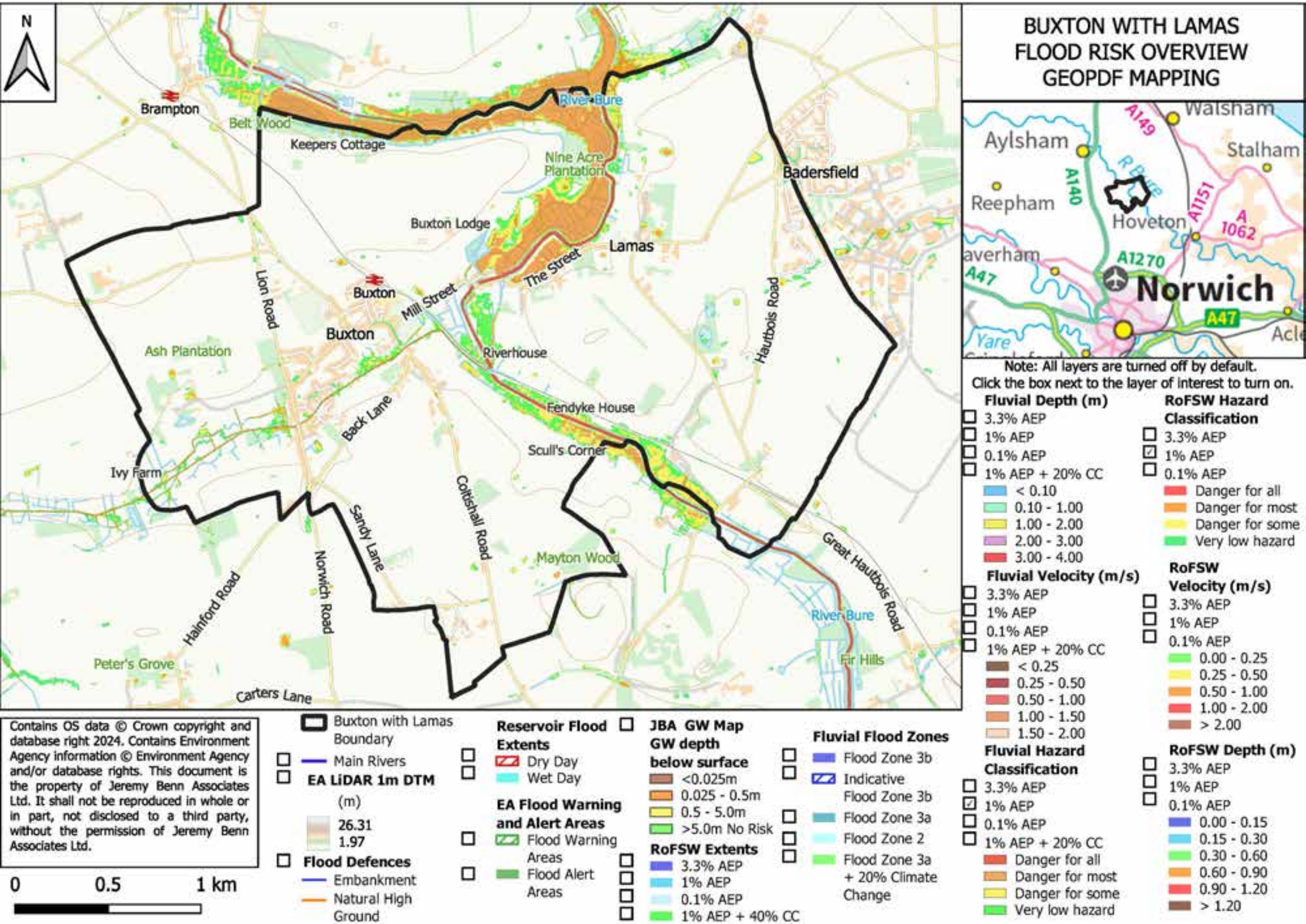
RoFSW Extent and Fluvial Flood Zones Combined: 1 in 100 year (1%) flood with climate change.



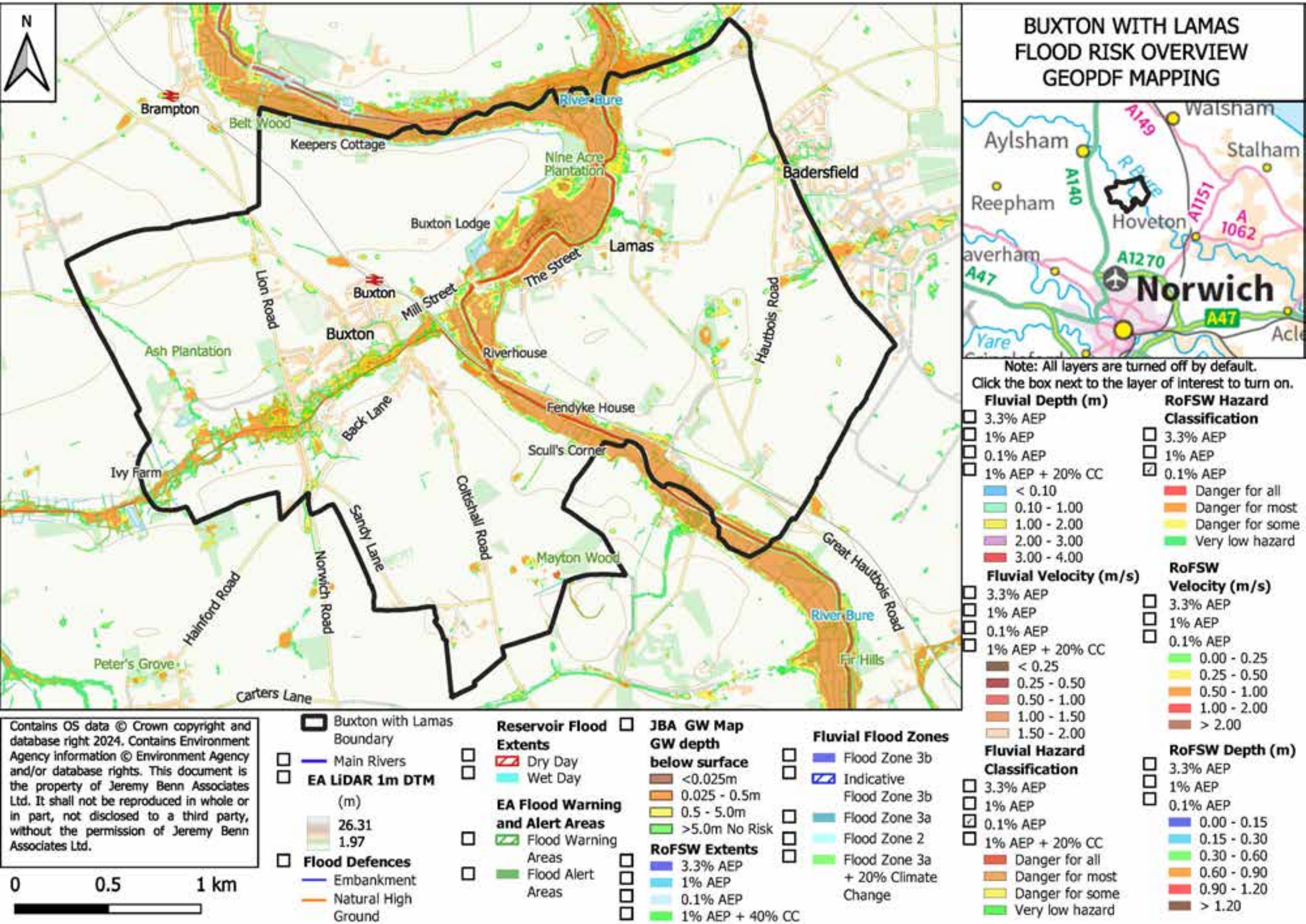
Fluvial and RoSFW Hazard Maps Combined: Classification for 1 in 33 year flood (3.3.%).



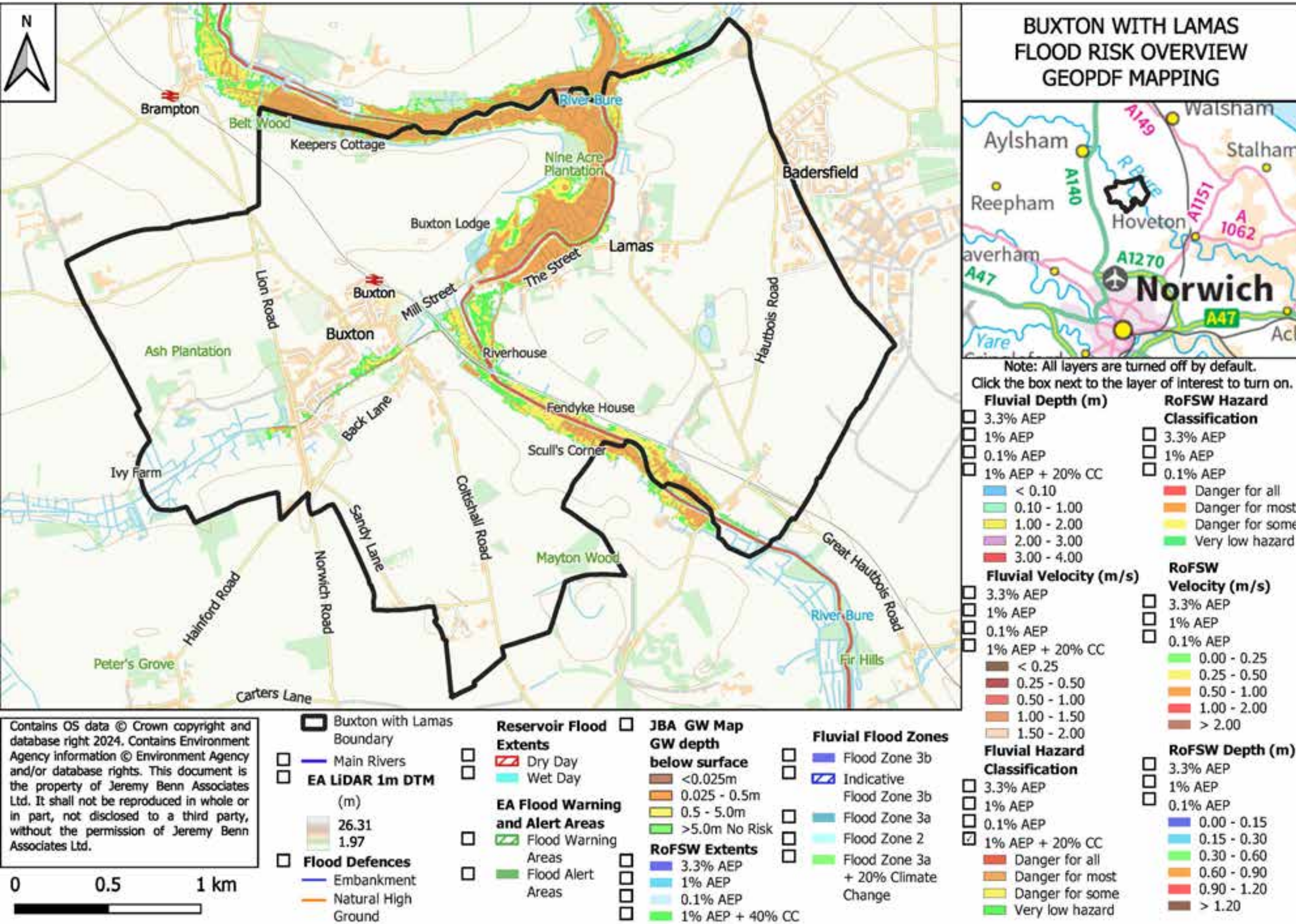
Fluvial and RoSFW Hazard Maps Combined: Classification for 1 in 100 year flood (1.%).



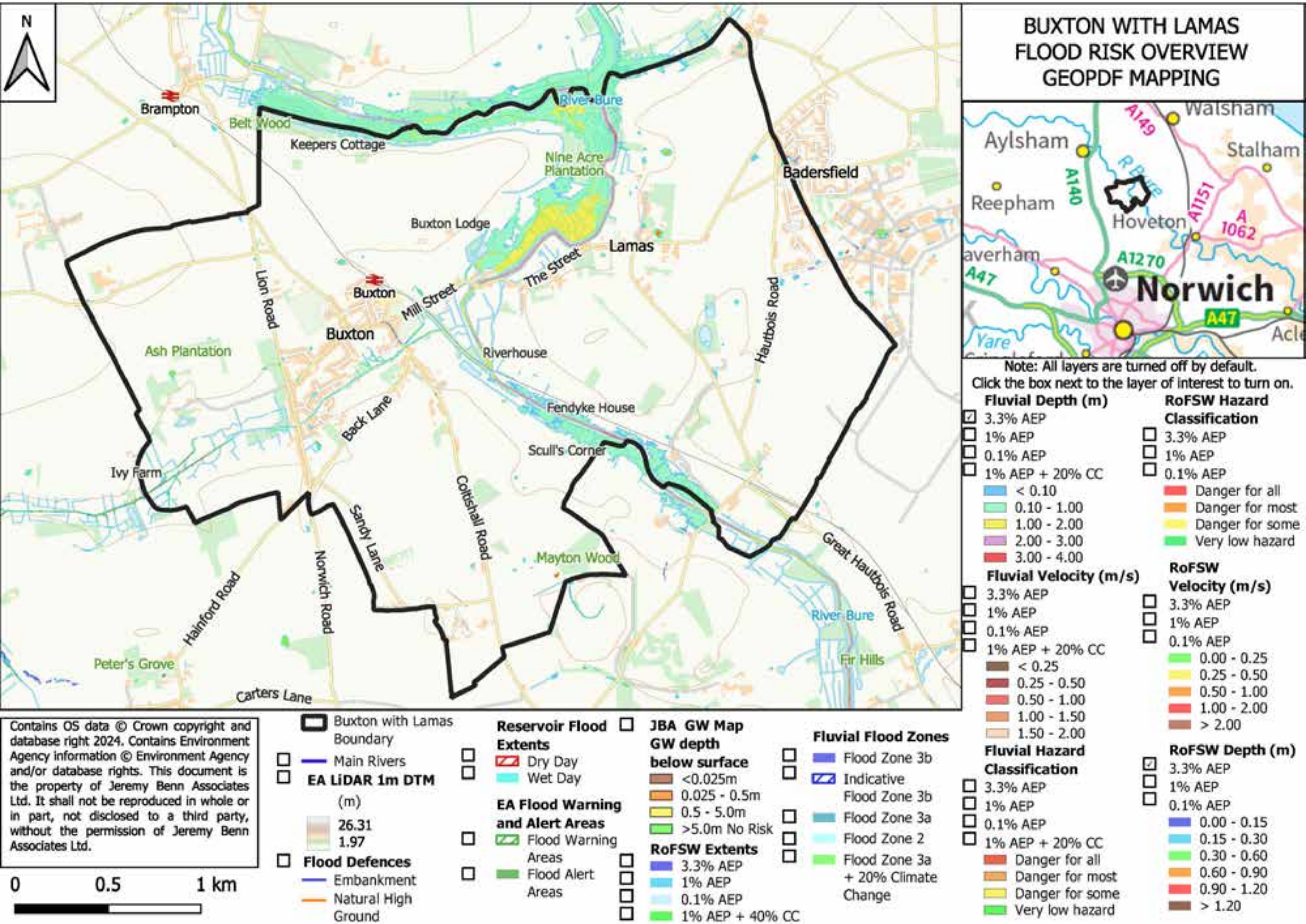
Fluvial and RoSFW Hazard Maps Combined: Classification for 1 in 1000 year flood (0.1.%).



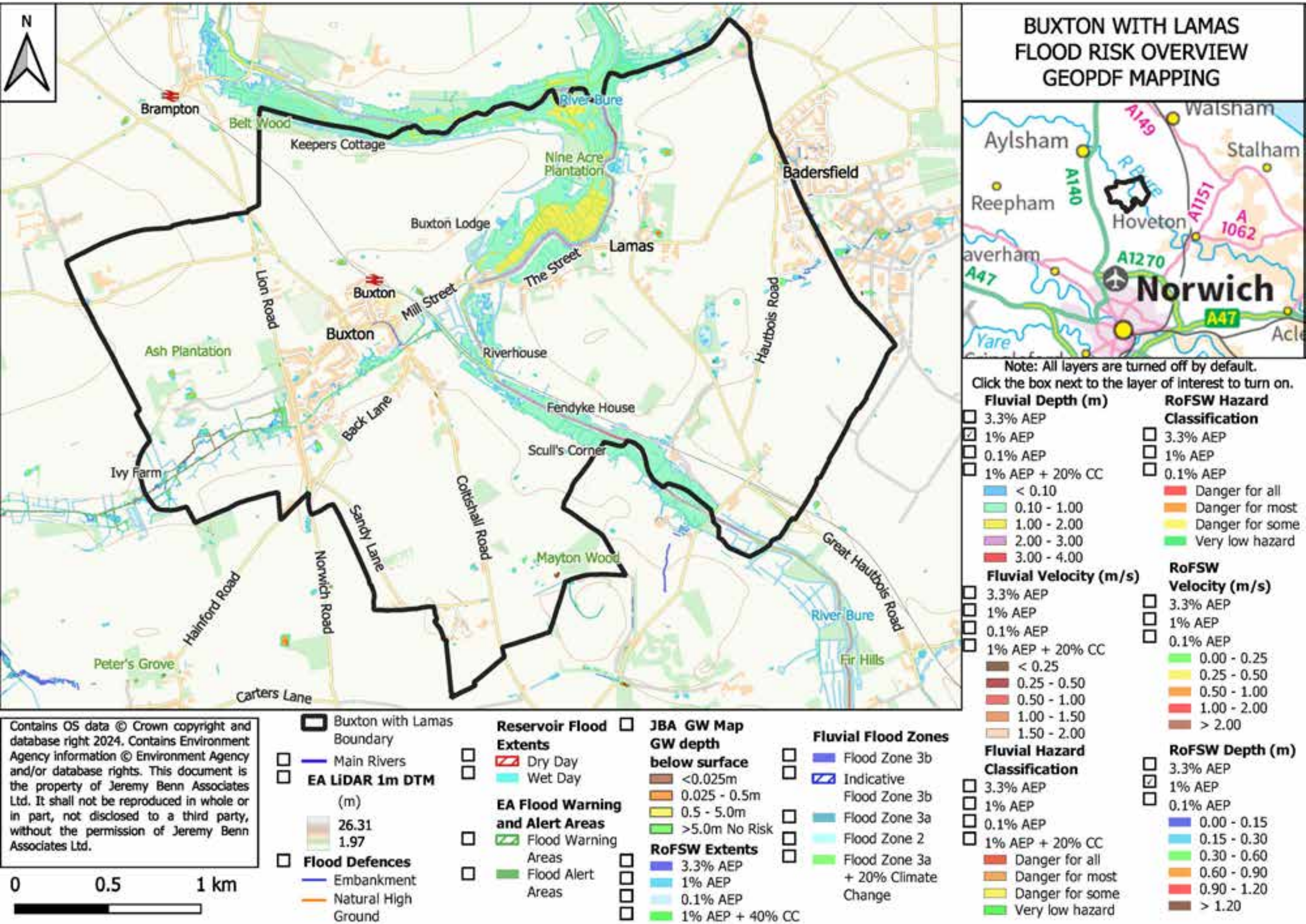
Fluvial Hazard Map: Classification for 1 in 100 year flood (1.%) with climate change



Fluvial and RoSFW Depth Maps Combined: Classification for 1 in 33 year flood (3.3.%).

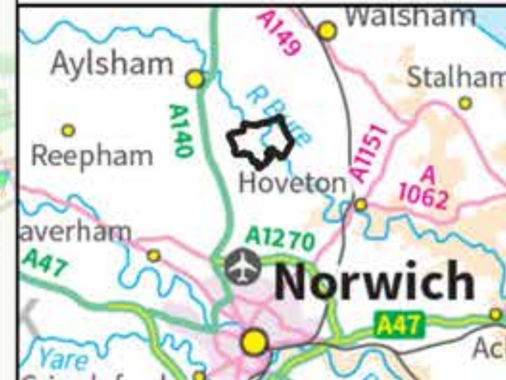


Fluvial and RoSFW Depth Maps Combined: Classification for 1 in 100 year flood (1.%).



Fluvial and RoSFW Depth Maps Combined: Classification for 1 in 1000 year flood (0.1%).

BUXTON WITH LAMAS
FLOOD RISK OVERVIEW
GEOPDF MAPPING



Note: All layers are turned off by default.
Click the box next to the layer of interest to turn on.

Fluvial Depth (m)
- ☐ 3.3% AEP
- ☐ 1% AEP
- ☑ 0.1% AEP
- ☐ 1% AEP + 20% CC
- < 0.10
- 0.10 - 1.00
- 1.00 - 2.00
- 2.00 - 3.00
- 3.00 - 4.00

RoFSW Hazard Classification
- ☐ 3.3% AEP
- ☐ 1% AEP
- ☐ 0.1% AEP
- Danger for all
- Danger for most
- Danger for some
- Very low hazard

Fluvial Velocity (m/s)
- ☐ 3.3% AEP
- ☐ 1% AEP
- ☐ 0.1% AEP
- ☐ 1% AEP + 20% CC
- < 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00

RoFSW Velocity (m/s)
- ☐ 3.3% AEP
- ☐ 1% AEP
- ☐ 0.1% AEP
- 0.00 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- > 2.00

Fluvial Hazard Classification
- ☐ 3.3% AEP
- ☐ 1% AEP
- ☐ 0.1% AEP
- ☐ 1% AEP + 20% CC
- Danger for all
- Danger for most
- Danger for some
- Very low hazard

RoFSW Depth (m)
- ☐ 3.3% AEP
- ☐ 1% AEP
- ☑ 0.1% AEP
- 0.00 - 0.15
- 0.15 - 0.30
- 0.30 - 0.60
- 0.60 - 0.90
- 0.90 - 1.20
- > 1.20

0 0.5 1 km

- Buxton with Lamas Boundary
- ☐ Main Rivers
- ☐ **EA LiDAR 1m DTM** (m)
  - 26.31
  - 1.97
- ☐ **Flood Defences**
  - Embankment
  - Natural High Ground

Reservoir Flood Extents
- ☐ Dry Day
- ☐ Wet Day

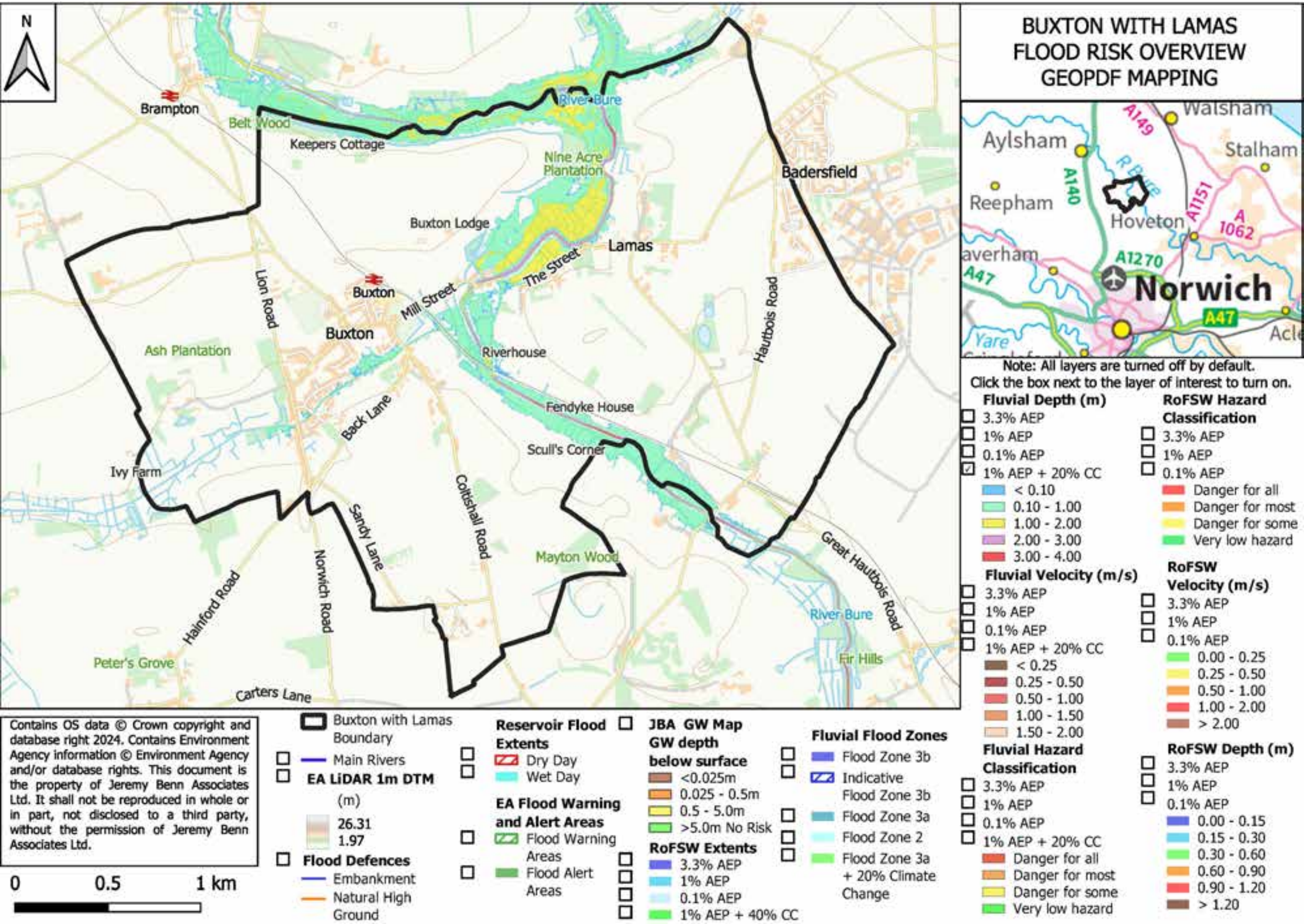
EA Flood Warning and Alert Areas
- ☐ Flood Warning Areas
- ☐ Flood Alert Areas

☐ **JBA GW Map**
GW depth below surface
- <0.025m
- 0.025 - 0.5m
- 0.5 - 5.0m
- >5.0m No Risk

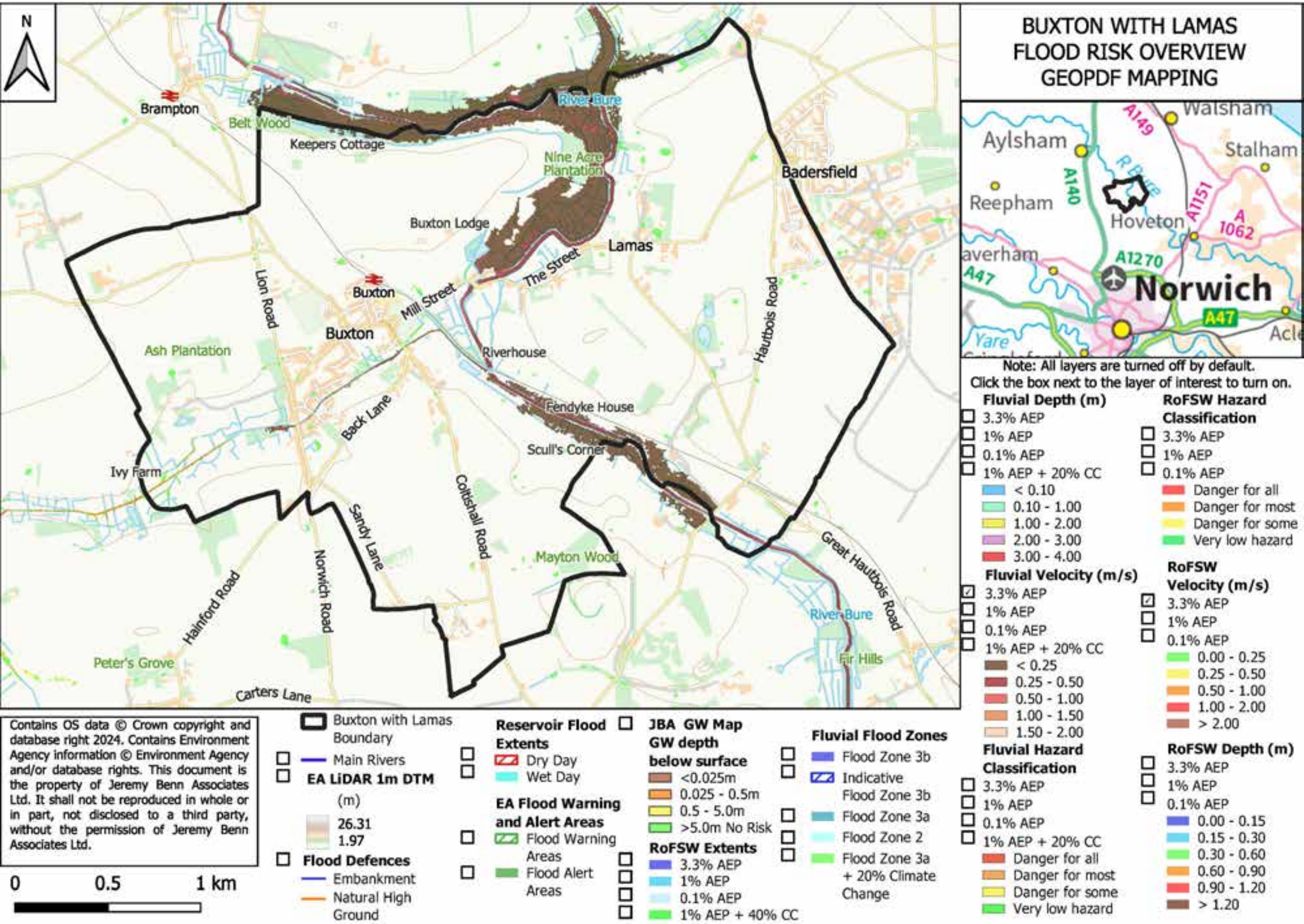
RoFSW Extents
- ☐ 3.3% AEP
- ☐ 1% AEP
- ☐ 0.1% AEP
- ☐ 1% AEP + 40% CC

Fluvial Flood Zones
- ☐ Flood Zone 3b
- ☐ Indicative Flood Zone 3b
- ☐ Flood Zone 3a
- ☐ Flood Zone 2
- ☐ Flood Zone 3a + 20% Climate Change

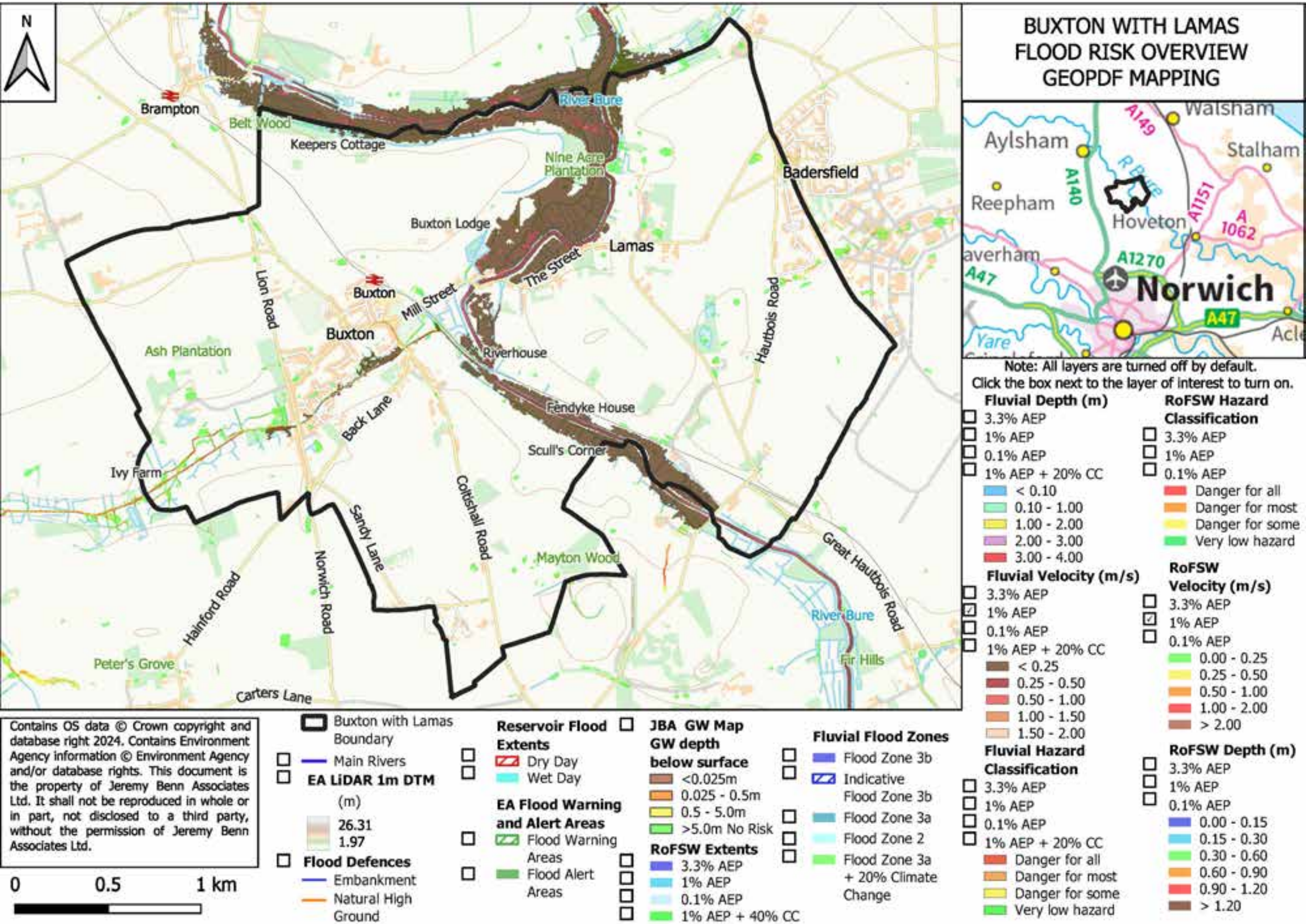
Fluvial Depth Map: Classification for 1 in 100 year flood (1.%) with climate change.



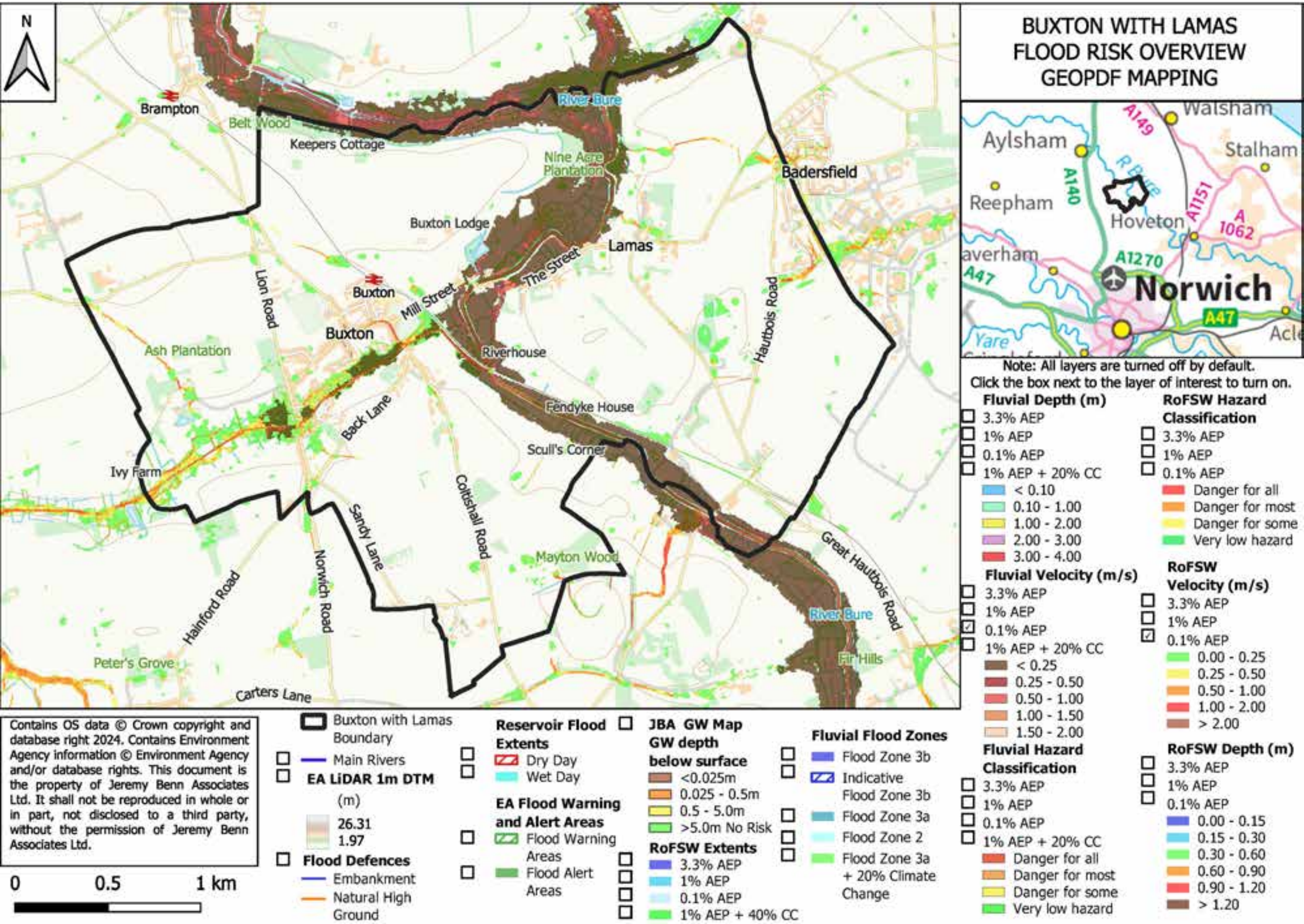
Fluvial and RoSFW Velocity Maps Combined: Classification for 1 in 33 year flood (3.3.%).



Fluvial and RoSFW Velocity Maps Combined: Classification for 1 in 100 year flood (1%).



Fluvial and RoSFW Velocity Maps Combined: Classification for 1 in 1000 year flood (0.1%).



Fluvial Velocity Map: Classification for 1 in 100 year flood (1.%) with climate change.