FLOOD RISK ASSESSMENT

PROPOSED MINERAL EXTRACTION AT BOURBLES FARM

Report Reference: 3133/FRA
Final version F1
June 2023

Report prepared for:

The Baxter Group
Marquis St
KIRKHAM
Preston
PR4 2HY

Barkers Chambers • Barker Street • Shrewsbury • United Kingdom • SY1 1SB
T: 01743 355770 • *F*: 01743 357771 • *E*: info@hafrenwater.com

GENERAL NOTES

Title of report: Flood Risk Assessment

Site: Bourbles Farm Quarry

Report ref: 3133/FRA

Date: June 2023

Version	Date	Issued to
Draft D1	17th November 2021	Simon Rees, Greenfield Environmental Ltd
Draft D2	1st April 2023	Simon Rees, Greenfield Environmental Ltd
Draft D3	9th June 2023	Simon Rees, Greenfield Environmental Ltd
Final F1	22nd June 2023	Simon Rees, Greenfield Environmental Ltd

Author(s): Peter Dunn BSc MSc

Updated 2023 by:

Chris Ainscow BSc Hons

Charlotte Hale BSc Hons MCIWEM

Reviewer: Chris Leake BSc MSc FGS

https://hafrenw.sharepoint.com/sites/HafrenWater/Shared Documents/General/Projects/Bourbles Farm (3133)/Reports/FRA/Draft/3133-FRA-F1 (June 2023).docx

CONTENTS

TABLES

DRAWINGS

APPENDICES

1 INTRODUCTION

1.1 Background

Bourbles Farm is located immediately east of the town of Preesall, on the North Fylde coast of Lancashire, located 3 km inland from the River Wyre estuary. The Application Area currently comprises 22.3 hectares (ha) of agricultural land and several fishing lakes. A 13.1 ha area has been dedicated to the extraction of the underlying superficial sand and gravel deposits. Mineral extraction will be undertaken on a campaign basis across five phases, with Phase A taking place prior to the establishment of the plant area. The mineral is situated below the watertable and dewatering will therefore be required to permit safe and efficient working, with the exception of Phase 1, which will be worked wet. The mineral will be processed on-site. Progressive restoration will be undertaken using overburden and imported inert materials.

The site is greater than 1 ha and is located within the Environment Agency's Flood Zone 3, where the probability of fluvial flooding in any one year could be 1% or greater and from the sea 0.5% or greater. The area is identified to benefit from flood defences. All planning applications for proposed developments in Flood Zone 2 and 3 or over 1 ha in size must be accompanied by an FRA.

Hafren Water was commissioned by Greenfield Environmental to undertake the requisite Flood Risk Assessment (FRA).

1.2 Scope of the assessment

The site is located entirely within Flood Zone 3 on the Environment Agency's (EA) Flood Map for Planning. Flood Zone 3 is land designated as having a 1% or greater annual probability of river flooding, or land having a 0.5% or greater probability of tidal flooding.

This FRA considers the likelihood of flooding to and from the site. Consideration is given to the risk from fluvial flooding and rainfall events with a return period of 1 in 100-years (unless otherwise stated) and includes an adjustment for the effects of potential future climate change.

1.3 National Planning Policy and Guidance

This FRA has been undertaken in accordance with the statutory requirements of the National Planning Policy Framework (NPPF) and Planning Practice Guidance (PPG) regarding development and flood risk.

1.4 Data sources

The following data sources have been used in this assessment:

Greenfield Environmental Ltd

- Site plans
- Mineral investigation borehole logs
- Groundwater monitoring data
- Restoration plan

Ordnance Survey (OS)

- 1:25,000 and 1:50,000 series mapping

British Geological Survey (BGS)

- Geology viewer (BGS website) and Webmap Service

Cranfield Soil and Agrifood Institute (landis.org.uk website)

- Soils map

Environment Agency (EA)

- Product 4 and 8 supplied 16th September 2021 (*Appendices 3133/FRA/A4* and *A5*)
- Flood risk maps for flooding from rivers and surface water (as WMS layers)
- Historical flood risk map (as WMS layer)

Lancashire County Council (LCC)

- Joint Lancashire Minerals and Waste Development Framework Core Strategy, February 2009
- Lancashire and Blackpool Local Flood Risk Management Strategy (LFRMS), October 2013
- Pre-application Standing Advice (undated)

Wyre District Council (WDC)

- Local plan 2011–2031, adopted February 2019
- Strategic Flood Risk Assessment Level 1, July 2016
- Strategic Flood Risk Assessment Level 2, October 2016

1.5 Local policy

LCC as the Lead Local Flood Authority (LLFA) is responsible for ensuring local policy is consistent with national policy. Both the LCC and WDC are responsible for encouraging sustainable development, and to ensure adherence to NPPF requirements with regards to flood risk management.

2 BASELINE CONDITIONS

2.1 Location and setting

The Application Area ('the site') is accessed from Lancaster Road, 250 m from the A588 (Head Dyke Lane), National Grid Reference (NGR) SD 37782 47617 and nearest postcode FY6 0PE. The site comprises six land parcels separated by buildings, a buried gas main/water pipe and a lake (*Drawing 3133/FRA/01 and Appendix 3133/FRA/A1)*.

A caravan site exists within the site boundary to the west, and six properties are located immediately adjacent to the Application Area, within 50 m of the site boundary to the north, south and west (see *Drawing 3133/FRA/01*). Preesall and Knott End-on-Sea villages are 710 m and 790 m to the southwest and northwest, respectively. The site currently comprises 22.3 ha of grazed and arable agricultural land and three fishing lakes. Limited areas of mineral have historically been extracted to create the fishing lakes. The surrounding area is characterised by small villages and mixed agricultural land use.

2.2 Topography

The Application Area lies in an extensive area of very low relief on the Fylde coastal plain, located between 5 -10 metres Above Ordnance Datum (mAOD). A series of small, raised areas (drumlins) are located to the west of the site, with the highest local elevation of 25 mAOD recorded near Preesall, 1.8 km to the southwest of the site.

The Application Area is located on a slightly raised area of ground, with a break in slope at the northern and southern site boundaries, approximately coinciding with the 5 mAOD contour line on OS maps. Within the site boundary, spot heights are between 4.8–6.7 mAOD and the topography is gently undulating. There is no single dip direction and ground levels decline in all directions towards the site boundaries.

2.3 Ground conditions

BGS mapping shows that the bedrock within the area local to the site is completely concealed by superficial deposits. The site is underlain by sandstones of the Sherwood Sandstone Group, described as a red sandstone.

The superficial deposits, which form the economic mineral, comprise raised storm beach sand and gravel deposits. The economic mineral is shown on British Geological Survey (BGS) mapping as an elongate deposit, moving inland from the coastline. Evidence from the mineral investigation indicates the economic mineral is entirely underlain by a sandy silt assumed to be the tidal flats, with the Till deposits identified at depth.

Overlying these deposits, the soils are classified by the Cranfield Soilscape mapping as '*loamy and clayey soils of coastal flats with naturally high groundwater*'. Mineral investigation at the site indicates the presence of soil overburden, with an average thickness of 0.5 m. Limited areas of thick (2.3–3.1 m) peaty soils, overburden silt and overburden peat were recorded within the southern and western extent of the site, outside of the mineral extraction area.

The Sherwood Sandstone Group is classed by the EA as a Principal Aquifer and is a regionally important groundwater resource for industrial use and public water supply.

The marine sand, blown sand, raised storm beach and the glaciofluvial deposits are classed as Secondary A Aquifers. These are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.

The Till deposits have been classed as a Secondary Undifferentiated Aquifer, where it has not been possible to attribute either category A or B to a rock type. Lastly, the Tidal Flats and Peat deposits are classed by the EA as non-aquifers, however Peat deposits usually store limited volumes of water.

Groundwater level monitoring was conducted on six occasions between March 2021 and January 2023 at four groundwater piezometer installations. Groundwater levels have been recorded between 0.33–2.01 metres below ground level (mbgl). Groundwater elevations are recorded between 4.25–5.61 mAOD. Groundwater egress from the economic mineral is considered to be radial, draining to the peripheral land drains.

There is insufficient data to determine whether cyclical seasonal variation in groundwater levels occurs. However, initial data indicates that winter rainfall may cause an increase in groundwater levels of between 0.5–1.0 m. Flooding of the local field drains to ground level was observed during March 2021.

2.4 Hydrology

Hydrological characteristics of the site and its environs have been derived from Ordnance Survey and online mapping and a site visit on 16th September 2021 (*Drawing 3133/FRA/02)*.

2.4.1 Watercourse

The site is located across the catchment divide between the River Wyre, 3 km to its west and Pilling Water/Broad Fleet, 3 km to the east. Field drains commencing 650 m to the west of the site flow directly to the River Wyre and further drains commence 700 m to the east of the site boundary flow towards Piling Water/Broad Fleet.

Drainage in the surrounding area is dominated by field edge ditches and dykes, the largest of which are Wheel Foot Watercourse, Middle Dyke and Cocker's Dyke. These are designated as 'Main' rivers by the EA and flow into Morecombe Bay, 3 km to the northwest of the site. The headwaters of the latter two drains commence close to the northern boundary of the site.

A separate network of drains also designated as 'Main' rivers drain areas to the south of the site. The headwaters of these drains commence in the southern part of the site and then flow southwards, to Stalmine Watercourse and eventually the River Wyre, 3.5 km to the southwest of the site.

Section 3.2.1 of the LFRMS (2013) refers to several pumping stations throughout the area, particularly near the coast, where pumping is needed to ensure that water will discharge when sea levels are high. It is reported that many of the drainage ditches and pumping stations are operating at or near full capacity.

Greenfield Environmental observed that at the time of the mineral investigation in March 2021, during very wet weather conditions, the majority of the land drains surrounding the site flooded. The land drain which borders the eastern site boundary did not flood. This eastern boundary drain continues northwards via several ditches and culverts, connecting to several other land drains, ultimately draining to Cocker's Dyke.

2.4.2 Waterbodies

Three fishing lakes are located within the site boundary with water levels at approximately 5.2–5.3 mAOD (Lidar, 2017 data). A visual inspection conducted during the site visit in September 2021 indicated that these waterbodies are unlined - small sections of their sidewalls are supported by a retaining metal wall. A fourth fishing lake is located adjacent to the western site boundary. This waterbody is understood to be constructed within made ground. The water level is at approximately 5.15 mAOD (Lidar, 2017 data).

There are no springs within 2 km of the site shown on the 1:25,000-scale OS map.

2.4.3 Flood zone and vulnerability classification

Mapping produced by the EA shows that the site lies within Flood Zone 3 (high probability of fluvial and tidal flooding) in an area benefitting from flood defences. This zone comprises land assessed as having a 1 in 100 (1%) or greater annual probability of river flooding; or land having between a 1 in 200 (0.5%) or greater annual probability of sea flooding.

In accordance with the NPPF and associated PPG, all planning applications for proposed developments within Flood Zones 2 or 3 or over 1 ha in size must be accompanied by an FRA.

The proposed sand and gravel extraction is considered to be 'Water Compatible' in accordance with the NPPF and PPG. The site is located wholly within Flood Zone 3. According to Table 3 of the PPG, it is considered appropriate for 'Water Compatible' development to be located within Flood Zone 3. The Sequential Test is therefore considered to be passed, and the Exception Test does not need to be applied.

2.4.4 Flood defences and flood warning

The coastal peninsular contains a network of embankments, revetment systems and sea walls which protect most of the area from flooding up to a standard of protection of between a 1 in 7-year and 1 in 200-year annual probability events (SFRA Level 2, 2016). The coastline closest to the site contains embankments which the EA record as providing a 1 in 200-year standard of protection that are in a fair condition (*Appendices 3133/FRA/A3* and *A4*).

Flood alerts are issued so that an area can prepare for flooding. Alerts are available for fluvial flooding from the Lower River Wyre (012WAFLW) and for coastal flooding from Cockerham to Fleetwood (012WACCF).

The nearest flood warning areas along the Lancashire coastline are for Over Wyre, between Wrampool Bridge, Preesall and Knott End (012FWCTL19B). The site is also located within the flood warning area for pumped watercourses known as Wheelfoot Watercourse, Cocker's Dyke, and Middle Dyke, near Perusal (012FWFL23A), Lancashire (*Appendices 3133/FRA/A3* and *A4*).

3 BACKGROUND AND KEY DOCUMENTS

3.1 National Planning Policy Framework (NPPF) and Planning Practice Guidance (PPG)

This FRA has been undertaken in accordance with the statutory requirements of the NPPF and PPG with regard to development and flood risk, to ensure that flood risk is taken into account at all stages of the planning process and to avoid inappropriate development in areas potentially at risk of flooding.

The NPPF requires developments to:

- Consider climate change over the longer term to avoid increased vulnerability to the range of impacts arising from climate change
- Ensure new development does not increase flood risk elsewhere
- Avoid inappropriate development in areas at risk of flooding by directing development away from areas at highest risk
- Where development is necessary, make it safe without increasing flood risk elsewhere and direct the most vulnerable development to areas of lowest flood risk
- Be supported by an appropriate site-specific Flood Risk Assessment, where one is required.
- Ensure development is appropriately flood resilient and resistant

Major development should incorporate sustainable drainage systems (SuDS) which should meet the Technical Standards for SuDS. Major development, according to Section 2 of Statutory Instrument 2015 Nº 595, Town and Country Planning of England, includes the winning and working of minerals or the use of land for mineral-working deposits, also waste.

3.2 Local Policies and Guidance

3.2.1 Wyre Borough Council Strategic Flood Risk Assessment Level 1

The NPPF states that Local Plans should be supported by a Strategic Flood Risk Assessment (SFRA), which refines information regarding the probability of flooding, taking all sources of flooding and the impacts of climate change into account. SFRA's provide the foundation for applying the Sequential Test, on the basis of the Flood Zones.

The WBC Strategic Flood Risk Assessment (SFRA) was completed by Wyre Council in July 2016. Key points of the SFRA relevant to the site include:

The SFRA recommends that all new development should aim to minimise areas of impermeable ground to reduce surface water run-off and SuDS should be used on all new development unless it is proved to be unfeasible.

It should be demonstrated that a proposed drainage scheme, and site layout and design, will reduce the risk of flooding to properties from surface water, so development is safe.

Historic flood events in the Wyre are recorded. The nearest flood event to the site boundary was in the village of Preesall, approximately 750 m west, in September 2012. This was a result of excess discharges to a culvert following 80% of the average monthly rainfall falling over a 48-hour period.

The SFRA does not raise any concerns for this development.

3.2.2 Wyre Borough Council Level 2 SFRA

In October 2016, JBA Consulting produced a Level 2 SFRA for the WBC. This provides a detailed assessment of sites identified in the Level 1 SFRA to be at risk of flooding, to determine any sites wholly unsuitable for development and ensure the careful management and appropriate mitigation for sites with potential for development.

The Level 2 SFRA has split the borough into four district Community Areas, one of which covers Pilling, Knott End-on-Sea and the Hambleton, where the site is located.

Section 3.3 'Community Assessment 2: Pilling' contains the following information relevant to the site:

- this Community Area currently benefits from hard linear defences along the coast, which are designed to protect the area to a 0.5% (1 in 200-year) Annual Exceedance Probability Standard of Protection (SoP). During the defended scenario, existing defences protect all sites proposed for development from coastal flooding
- Developers should undertake at least a Level 2 SFRA for all sites due to the high risk of surface water flooding
- SuDS should be a high priority to reduce pressure on the existing drainage system as well as blue/green infrastructure along watercourses
- Defended fluvial and tidal flood depths and extents provided in this SFRA should be used to assess actual risk to the site

The Level 2 SFRA does not raise any site-specific concerns for this development and the above information has been considered throughout this assessment.

3.2.3 Lancashire County Council Preliminary Flood Risk Assessment

Preliminary Flood Risk Assessments (PFRA's) were a requirement of the Flood Risk Regulations (2009) and were produced by Lead Local Flood Authorities (LLFA's). Their purpose is to provide information on significant historical flood events and summarise future flood risk from all sources of flooding.

The LCC PFRA was completed in May 2011. Historical incidents of flooding have been recorded across the study area, however there are no records of flooding affecting the site.

The PFRA does not raise any concerns for this development.

3.2.4 Lancashire County Council Local Flood Risk Management Strategy

The need for a LFRMS is governed by the Flood and Water Management Act 2010, which places a statutory duty on LLFA's to develop, maintain, implement and monitor an approach for managing local flood risks in its area.

LCC is the LLFA for this area, and its Local Flood Risk Management Strategy (LFRMS), was published in November 2021.

The LFRMS has identified, at a strategic level, priority flood risk areas; none of which overlap the proposed site. More generally, the LFRMS states:

- Major development should incorporate sustainable drainage systems (SuDS), which should meet the Technical Standards for SuDS
- We will encourage developers and planners to use sustainable drainage systems components, where possible, to enhance biodiversity and add amenity value to development in line with national and local planning requirements
- Local Planning Authorities will require a locally adapted SuDS pro-forma to be submitted for every major planning application
- All new sustainable drainage systems on developments incorporate an allowance for climate change consistent with national and/or local planning requirements.

The LFRMS does not raise any concerns for the site.

3.2.5 Wyre Local Plan 2011-2031

The Local Plan for the WBC was adopted in February 2019 and underwent a partial update in January 2023. The plan sets out a strategic framework for development in the Borough over the period until 2031.

Policy 6.3 Flood Risk and Surface Water Management (CDMP2) reads as follows:

'Development will be required to demonstrate that:

a) It will not be at an unacceptable risk of flooding; and

b) It would not lead to an increased risk of flooding elsewhere.'

'Where development is proposed in areas at risk of flooding, unless specifically proposed in this Local Plan, it must be demonstrated that the Sequential Test has been applied and there are no reasonable available alternative sites at lower risk, considering the nature of flooding and the vulnerability of the development.'

'Sustainable drainage systems are expected, and discharges off-site will need to achieve greenfield rates.'

This policy has been considered throughout this assessment.

3.2.6 Joint Lancashire Minerals and Waste Local Plan

The Joint Lancashire Minerals and Waste Local Plan which covers the area was published by the Joint Authorities of Blackpool Council, Blackburn with Darwen Borough Council and LCC in September 2013.

This policy has been considered throughout this assessment.

3.3 Climate change

In May 2022 the EA published an update on climate change allowances for both peak river flows and peak rainfall intensity. The site is located within the Wyre Management Catchment.

3.3.1 Peak rainfall intensity

Climate change allowances for peak rainfall intensity have been specified for each management catchment and for different development lifetimes. The guidance states to: '*Use '2050s' for development with a lifetime up 2060 and use the 2070s epoch for development with a lifetime between 2061 and 2125.'*

The site is located in the Wyre Management Catchment, the following peak rainfall allowances have been selected:

3133/FRA/T1: Wyre Management Catchment – peak rainfall allowances

	30-yr return period		100-yr return period	
	Central	Upper	Central	Upper
2050's	25%	35%	25%	40%
2070's	30%	45%	35%	50%

The proposed lifetime of the quarry will be 6-7 years. This includes 5 years for mineral extraction and restoration work of 1.5 years. This puts the proposed development into the ‘2050s’ epoch. This type of development (mineral extraction) is not highly sensitive to flooding, and therefore a ‘central’ estimate is assumed to be applicable. For robustness, an ‘upper’ estimate of climate change allowance of 40% has been used to calculate run-off rates and volumes for the site.

4 PROPOSED DEVELOPMENT

4.1 Operational phase

The proposed operational site layout is provided as *Appendix 3133/FRA/A2*. The site has a total area of 22.3 ha with mineral extraction planned across approximately 13.1 ha. The superficial sand and gravel deposits form the economic mineral. Mineral will be extracted on a campaign basis over a 5-year period in five phases; Phase A within the plant site and mineral extraction Phases 1 to 4. A gas and water main cross the site, and consequently Phase 3 will be worked as two separate void areas (Phase 3-A and Phase 3-B) to account for the 'stand-off' zones required for each pipeline. Mineral extraction Phases A and Phase 1 to 4 are between 1 and 3.7 ha in size. Mineral extraction beneath the plant site will be undertaken as Phase A to create an area suitable for mineral processing. Removal of the plant site infrastructure will be undertaken as Phase 5.

Overburden will be stored in bunds around the edge of each Phase and be used for restoration. Suitable imported inert material for use in the restoration of each phase will also be stockpiled on site. Mineral would be processed on-site and stockpiled adjacent to the plant site.

A new haul road will be created to transport mineral from Phase 1 to the plant site; low screening bunds will be created along the edge of this internal road. The site will be accessed from Lancaster Road to the south, via a proposed new road. Sections of the plant and stocking area and quarry entrance road will be temporarily raised c1 m above the existing ground levels to 5 mAOD using permeable granular material for the duration of site operation. The plant site, including mineral extraction area Phase A, is 2.2 ha in size.

4.1.1 Operational water management

Mineral extraction from Phase 1, above the groundwater table, will be undertaken in a single cut during the summer months. Mineral below the groundwater table will be worked wet with no dewatering.

Mineral will be extracted below the watertable, which will necessitate active dewatering in Phases A, 2, 3 and 4. The site will be worked on a campaign basis, during the drier months of the year. Water from dewatering and from run-off generated across the plant site will be allowed to settle within a sump and discharged to the on-site waterbodies. Excess water, which cannot be managed on-site, will be discharged to the adjacent field drain network. These field drains flow generally northwards and ultimately discharge to the Cocker's Dyke Drain or Wheel Foot Watercourse. Flow to the sea from these drains is controlled by a flood gate located at the coast and operated by the EA.

No water supply is required for mineral processing. Water from a freshwater lagoon adjacent to the plant site will be used for dust suppression within the plant area, and to supply a wheel wash. Settled clean water will be recirculated from the silt lagoon to the freshwater lagoon, and the system will be periodically topped up using water from dewatering.

Silt from the Tidal Flats will be dug out wet using a long reach excavator and, together with the underlying clay, will be used to line the sides of the quarry void to reduce groundwater ingress. This will help to reduce the dewatering requirement.

4.2 Restoration

4.2.1 Proposed restoration

The proposed restoration scheme is provided as *Appendix 3133/FRA/A3*. The site will be progressively restored on a campaign basis using overburden and interburden sourced on-site, and suitable imported inert material, with the final restoration and landscaping anticipated to be completed over ~1.5 years. The total lifetime of the site is therefore 6–7 years. One of the fishing lakes within the site boundary will be infilled and designated as wooded area. New fishing lakes will be created in Phases 1 to 4.

The remainder of the site will be returned to original ground levels for agricultural and equestrian use. The plant site area will be restored to original ground elevation levels to be converted to a caravan and holiday park (this change of use will be assessed under a separate planning application).

4.2.2 Water management post-restoration

Following completion of infilling, surface run-off from the restored quarry will revert to greenfield conditions and active water management measures are not required. Surface water run-off will be captured by the existing field drain network.

5 FLOOD RISK AT THE SITE

5.1 Potential Sources of flooding

The risk of flooding to the site has been assessed by examining the likelihood (frequency or return period) of flooding and the consequences of flooding (property damage, disruption and in extreme cases fatalities), which typically depend on flood depth, velocity, speed of onset and duration. A qualitative assessment of the consequences of flooding to the site has been made from a range of potential flood sources:

Potential sources of flooding to the site are:

- Fluvial
- Tidal
- Pluvial (surface water run-off)
- Groundwater
- Sewer and drains
- Reservoir, canals and Lakes
- Other artificial sources

5.2 Historical flooding

The Environment Agency has confirmed that it does not hold any records of historic flooding affecting the site as shown on *Drawing 3133/FRA/04*.

There is no known history of flooding at the site.

5.3 Fluvial flooding

EA flood mapping of fluvial events (*Appendix 3133/FRA/A6*) has been taken from a document referred to by the Agency as the 'Preesall 2018 study'. Flood mapping for 1 in 100-year (1% annual exceedance probability) and 1 in 1,000-year (0.1% annual exceedance probability) return period events has been provided, also for these events with a climate change adjustment of 70%. Both defended and undefended scenarios are represented although it is unclear what fluvial flood defences are involved as only details of coastal flood defences have been provided.

Fluvial flood risk mapping (*Drawing 3133/FRA/03* and *Appendix 3133/FRA/A7*) shows that a 30 m corridor next to the northern boundary of land parcel 4 is exposed to fluvial flood risk during a 1 in 100-year plus 70% climate adjusted event. Flooding is more sporadic and slightly lower (4.98 mAOD) for the defended scenario compared to the undefended (5.06 mAOD). If the presence of flood defences is ignored, more extensive flooding of land parcels to the south is prevented by the higher ground of these central areas. Therefore, remaining areas of the site are currently at no risk or very low risk of fluvial flooding, including the area that will contain the office and permanent plant.

Breach modelling of fluvial defences has not been provided but flood depths for the undefended scenario are relatively shallow (c0.1 m).

Mineral extraction will lower ground levels across the site and thereby remove a barrier to greater fluvial flooding if the presence of flood defences is ignored. It is conservatively assumed that this potential increase in fluvial flood risk will require mitigation.

5.4 Tidal flooding

Tidal flooding is the primary potential source of flooding to the site due to its proximity to the coast. EA flood mapping of tidal events (*Appendix 3133/FRA/A8*) has been sourced from the Lancashire Tidal ABD study, 2014. It is stated that modelling was updated with new sea level rise allowances in 2020 which have been applied to defended/undefended 1 in 200-year return period (0.5% annual exceedance probability) scenarios. The reported allowances are greater than values obtained from Table 2 of Environment Agency Sea Level Rise guidance (last updated October 2021) for the longer time horizon, which is more relevant to the restored site and are slightly lower for shorter time horizons compatible with the period of operation:

- 2069 grids – 370 mm sea level rise which is slightly less than (158 + 219 + (3 x 4.5)) = 390 mm from Table 2 of Environment Agency guidance
- 2119 grids – 970 mm sea level rise which is greater than (158 + 219 + 300 + (23 x 10)) = 907 mm from Table 2 of Environment Agency guidance

The EA has stated that it did not provide defended scenarios from the Tidal ABD Study 2014 because they do not affect the site.

Coastal defences closest to the site provide a 1 in 200 annual probability standard of protection with crest levels of at least 7.61 mAOD. The Environment Agency carry out frequent inspections of flood defences and have assessed those closest to the site as being in a 'fair' condition. This indicates that defects are possibly present which could reduce performance, but the chances of failure are considered low.

Existing ground levels within the site are typically 5.1 mAOD at the northern boundary, 5.0 mAOD within the proposed plant area towards the southern boundary and 6.3 mAOD to 6.6 mAOD towards the centre of the site. Mineral extraction will reduce the ground levels to the base of the sand and gravel deposits, estimated to be between 0.5 and 4 mAOD.

If the presence of flood defences is ignored, EA tidal flood mapping of a 1 in 200 return period event (0.5% annual exceedance probability), inclusive of a sea level rise of 970 mm, shows that flooding near the northern extent of the site (land parcel 4) could reach an elevation of 7.36 mAOD. Flood levels will be slightly lower towards the southern extent of the site (plant area), 7.1 mAOD. The modelled flood levels for an undefended scenario suggest flood depths of just over 2 m in the lowest parts of the site (plant area before proposed raising).

Tidal flood mapping also shows flood levels in the event of a breach in flood defences during a 1 in 200 return period event (0.5% annual exceedance probability), inclusive of a sea level rise of 970 mm. This shows that flooding of the site would be limited to a 30 m corridor next to the northern boundary of land parcel 4. Tidal flood hazard mapping suggests flood depths of up to 0.5 m except in very small, isolated depressions and slow-moving water (<0.3 m/s). Higher ground in central areas of the site (land parcel 2) further to the south prevents more widespread flooding.

As an optional precautionary measure, the low flood risk could be further reduced if the site adopts an Emergency Flood Evacuation Plan that sets out evacuation procedures, routes and dry refuge. This would require registration with the EA to receive flood alerts and flood warnings which are available for the areas near the site as summarised in Section 6.1.2. The EA aims to give a lead time of 1 hour for fluvial flood warning, and 3 hours for the coastal flood warning. Whilst the time for floodwater to reach the site during a breach scenario is not known, knowledge of unusual flood conditions would at least raise awareness on-site. The nearness (<1 km) of low flood risk/dry refuge areas southwest of Preesall village makes for a safe evacuation, in the unlikely event that it would be necessary.

The probability of a breach in flood defences is very low. However, the lowering of ground levels across the site during mineral extraction will create an opportunity for more widespread flooding should a breach in defences occur. This represents a potential increase in tidal flood risk during operations which requires mitigation. The agricultural use of the restored site will not be sensitive to infrequent flooding.

The EA has suggested that flood defences protect most of the site from flooding during a 1 in 200-year tidal event inclusive of a 970 mm sea level rise allowance, also from a 1 in 100-year fluvial event inclusive of a 70% climate change adjustment.

The probability of a breach in flood defences is very low. Modelling of a breach in coastal defences suggests relatively shallow depths (<0.5 m) of tidal flooding would occur in a corridor of land along the northern site boundary of Phase 2. More widespread flooding across the site is limited by the higher ground of central areas to the south.

5.5 Surface water flooding

Surface water flooding occurs when rainwater does not drain away through the normal drainage system or soak into the ground, but instead, lies on or flows over the ground.

The construction of the plant area will involve the creation of a low permeability surface, which has the potential to increase surface run-off and flood risk to external areas. A site water management system will be implemented as part of the quarry design. This system will collect surface run-off in sumps for use on-site or for infiltration to ground. Any excess water will be discharged into the external field drainage system to the north of the site. The surface water management system will contribute to the mitigation of surface water flood risk and is explained in further detail in Section 6.

EA mapping (*Drawing 3133/FRA/05*) shows that surface water flood risk is confined to small watercourses and field edge drainage ditches. Except for a small number of insignificant areas, the site is not at risk of surface water flooding and no mitigation is required.

5.6 Groundwater flooding

Groundwater flooding occurs when the watertable rises above the ground surface. It is most likely in areas above an aquifer, where water levels can rise following prolonged rainfall.

Groundwater monitoring data has recorded groundwater levels between 0.33–2.01 mbgl. Groundwater levels were monitored to remain below ground level in March 2021 whilst the land drains were observed to be in flood.

Dewatering will be required to permit safe and efficient working conditions for mineral extraction and restoration. This would reduce groundwater levels in the immediate vicinity of the quarry void(s). Should dewatering operations be interrupted groundwater ingress would occur at rates that would permit evacuation or other remedial action to safeguard personnel and equipment. Following completion of restoration, dewatering activities will cease, and groundwater levels will recover.

Mitigation measures, in addition to implementation of the proposed site water management system, will not be required to manage groundwater flood risk during operation or following restoration.

5.7 Flooding from sewers and drains

Sewer flooding generally results in localised short-term flooding caused by intense rainfall events overloading the capacity of sewers. Flooding can also occur because of blockage, poor maintenance, structural failure or surcharging of the system due to high water levels in a receiving watercourse.

Mains water and gas pipelines pass through the centre of the site, as shown in *Appendix 3133/FRA/A1*. The pipeline does not pass through any areas of proposed mineral extraction and required stand-off distances will be maintained on either side of the pipelines.

The site has been used for agriculture and is located near areas of former mineral extraction. Although the site is located between the urban areas of Preesall and Knott End-on-Sea, the likelihood of a sewer system being present beneath the site is low, due to its rural location and existing agricultural land use.

The overall risk of flooding from sewers and water mains is ‘low’. Mitigation other than normal precautionary measures is not proposed during site operation or following restoration.

5.8 Flooding from reservoirs, canals and lakes

Reservoir and canal flooding occur after the failure or breaching of a dam wall or canal embankment and is rare in the UK due to regulatory inspections and maintenance.

There are no reservoirs or canals within the vicinity of the site. Four lakes are located within the site boundary, however these are situated below ground level and are not impounded.

It is therefore considered that the risk of flooding from reservoirs, canals and lakes is low.

5.9 Other artificial sources

There are no other artificial sources of flooding in the vicinity of the site. Therefore, the risk of flooding from such sources is very low.

6 SURFACE WATER DRAINAGE STRATEGY

The plant and stocking area will comprise a hardstanding area of 2.2 ha, formed of permeable granular material. This will be temporarily raised by c1 m above existing ground for the duration of operations. Surface run-off will be directed to a sump and will be used on-site. Excess water will either be pumped to the on-site waterbodies, or to the currently operating quarry void where it will gravitate to the lowest part of the quarry floor, or to an external drainage ditch to the north at a licensed rate and less than the greenfield rate for the site.

Off-site discharge will need to take cognisance of tide levels in Morecombe Bay so that existing flooding issues along receiving watercourses due to 'tide locking' are not exacerbated.

Estimates of greenfield run-off rates for the quarry site are given in Section 6.1.1. These rates have been used to assess off-site discharge constraints and stormwater management storage requirements in Section 6.1.2 for different phases of quarry development. The quarry will be developed on a campaign basis and run-off rates and storage requirements have been estimated for each development phase.

The ability to contain incident rainfall in quarry voids is assessed in Section 6.1.3.

6.1.1 Greenfield run-off

The peak 'greenfield' run-off rate from the pre-developed site has been estimated to assist with the determination of acceptable site discharge rates. Whilst planning policy assumes discharge at greenfield rates will limit potential increases in flood risk to downstream areas it would be prudent to check discharges will not cause flooding issues at culverts along the receiving watercourse.

The peak 'greenfield' run-off rate has been estimated using the IH124 method (implemented by the HR Wallingford online 'Tools for Sustainable Drainage Systems' https://www.uksuds.com/). The IH124 method to give a mean annual peak flow (Q_{BAR}) is of the form:

$$Q_{BAR(rural)} = 0.00108 AREA^{0.89} SAAR^{1.17} SOIL^{2.17}$$

Where:	$Q_{BAR(rural)}$	mean annual flood, with a return period of 2.3 years (m^3/s)
	AREA	total quarry affected area (km^2)
	SAAR (4170)	Standard Average Annual Rainfall (1941 to 1970) (mm) = 610
	SOIL	soil index = 0.4

A soil index (0.47) has been selected to be compatible with pre-development loamy and clayey soils with naturally high groundwater.

Q_{BAR}(rural), which is 6.81 l/s/ha, can be multiplied by the UK Flood Studies Report regional growth curve to obtain peak flood flows for any return period (*Table 3133/FRA/T2* and the calculation record is provided in *Appendix 3133/FRA/A9*).

3133/FRA/T2: Greenfield run-off peak rate					
Phase	Area (ha)	Q_{BAR} (l/s)	1 in 1-year (l/s)	1 in 30-year (l/s)	1 in 100-year (l/s)
Phase A mineral extraction void (excluding plant area)	1.7	11.6	10.1	19.7	24.1
Plant Area (including mineral extraction Phase A)	2.2	15.0	13.0	25.5	31.2
Phase 1	2.4	16.4	14.2	27.8	34.0
Phase 2	1	6.8	5.9	11.6	14.2
Phase 3-A	1.9	13.0	11.3	22.0	26.9
Phase 3-B	3.7	25.2	21.9	42.9	52.5
Phase 4	2.4	16.4	14.2	27.8	34.0

6.1.2 Working phase run-off and stormwater management storage requirements

An estimate of run-off during the operational phase of the quarry has been made using the Rational Method with run-off factors of 0.55 and 0.7 for quarry floor and plant areas, respectively. Under the NPPF, the storm event for drainage design purposes is that with a return period of 100 years plus an allowance for climate change. Climate change over the lifetime of the development will be represented by a 40% uplift in design storm rainfall (Section 3.3).

The quarry void will provide temporary attenuation storage during and following storm events. Storm rainfall will be directed to sumps located at the base of working areas and in the plant area. Excess water in the plant area will be either used on-site, or will be pumped into the on-site waterbodies, currently operating quarry void, or pumped off-site to the adjacent field drain network. Any water accumulating in the quarry void will be retained until it is used on-site, or it infiltrates or is discharged off-site at the Q_{BAR} greenfield rate. Furthermore, the quarry will be registered to receive local flood alerts and will not discharge off-site when notified by the EA during times of flooding.

The required stormwater management storage to be provided by sumps and excavated voids during each phase of quarry development is summarised in *Table 3133/FRA/T3 and* calculation records are given in *Appendix 3133/FRA/A9.* The results illustrate that the maximum depth of water accumulating in quarry voids during a design storm event is 135 mm.

3133/FRA/T3: Stormwater run-off and storage requirements

Phase	Raised plant area (ha)	Working area (ha)	A Critical storm duration (hrs)	B Run-off (l/s)	C Inflow volume (m^3)	D Outlet discharge volume (m^3)	E Required storage volume (m^3)	F Water depth in quarry void (mm)
A	N/A	1.7	8	35	1019	334	685	40
1	2.2	2.4	8	107	3093	766	2327	97
2	2.2	1	8	78	2254	903	1351	135
3-A	2.2	1.9	8	98	2816	628	2188	115
3-B	2.2	3.7	8	134	3872	1158	2714	73
4	2.2	2.4	8	124	3572	903	2669	83

A storm duration that creates the greatest storage requirement assuming outflow is restricted to Q_{BAR} greenfield rate
B run-off = 1 in 100-year plus 40% CC rate from working + plant area using Rational Method
C inflow = run-off multiplied by storm duration
D outflow = Q_{BAR} greenfield rate for the working + plant area (Table 3133/FRA/T2) multiplied by storm duration
E storage volume = inflow volume – outflow volume for storm duration
F water depth in quarry void = storage volume / working area

6.1.3 Water containment capacity of quarry voids

With a mean void depth of 3.9 m, and assuming off-site discharge at Q_{Bar} greenfield rates, a maximum storm rainfall run-off depth of 135 mm in Phase 2 will not cause overflow to surrounding areas. Therefore, the quarry voids will provide a larger than necessary buffer storage capacity for the management of stormwater run-off in addition to any significant storage created in sumps.

The lowering of ground levels across the site during mineral extraction will remove the barrier to more widespread flooding, albeit to a shallow depth, should a breach in flood defences occur. It is conservatively assumed that this potential increase in flood risk will require mitigation to maintain safe working during operations.

6.2 Post-restoration recommendations

Following the cessation of mineral extraction, the quarry voids will be partially infilled with overburden, silt and inert fill and the plant and office removed. Ground levels across the site will be restored to similar levels of pre-development conditions. Therefore, run-off rates will be similar to the greenfield conditions and no requirement for active water management is envisaged.

A number of open water features will be created, into which surface water run-off will be directed. Overflow from these features will be into the existing ditch network, away from sensitive receptors. Agricultural use will not be sensitive to infrequent and shallow flooding.

7 SUMMARY AND CONCLUSION

The proposed quarry would be operated to extract sand and gravel during the drier months of the year to limit dewatering requirements.

In the unlikely eventuality that a breach in the flood defences occurred, the removal of higher ground within the site may expose more of the site to tidal and fluvial flood risk. Modelling suggests this would represent a low hazard/'danger for some'. The risk is already mitigated by on-going maintenance of flood defences, which protect most of the site against a 1 in 200-year tidal event inclusive of a sea level rise of 970 mm and a 1 in 100-year plus 70% climate adjusted fluvial event. As a precautionary measure it is recommended that the site adopts an Emergency Plan that sets out flood warning and evacuation procedures, routes and dry refuge.

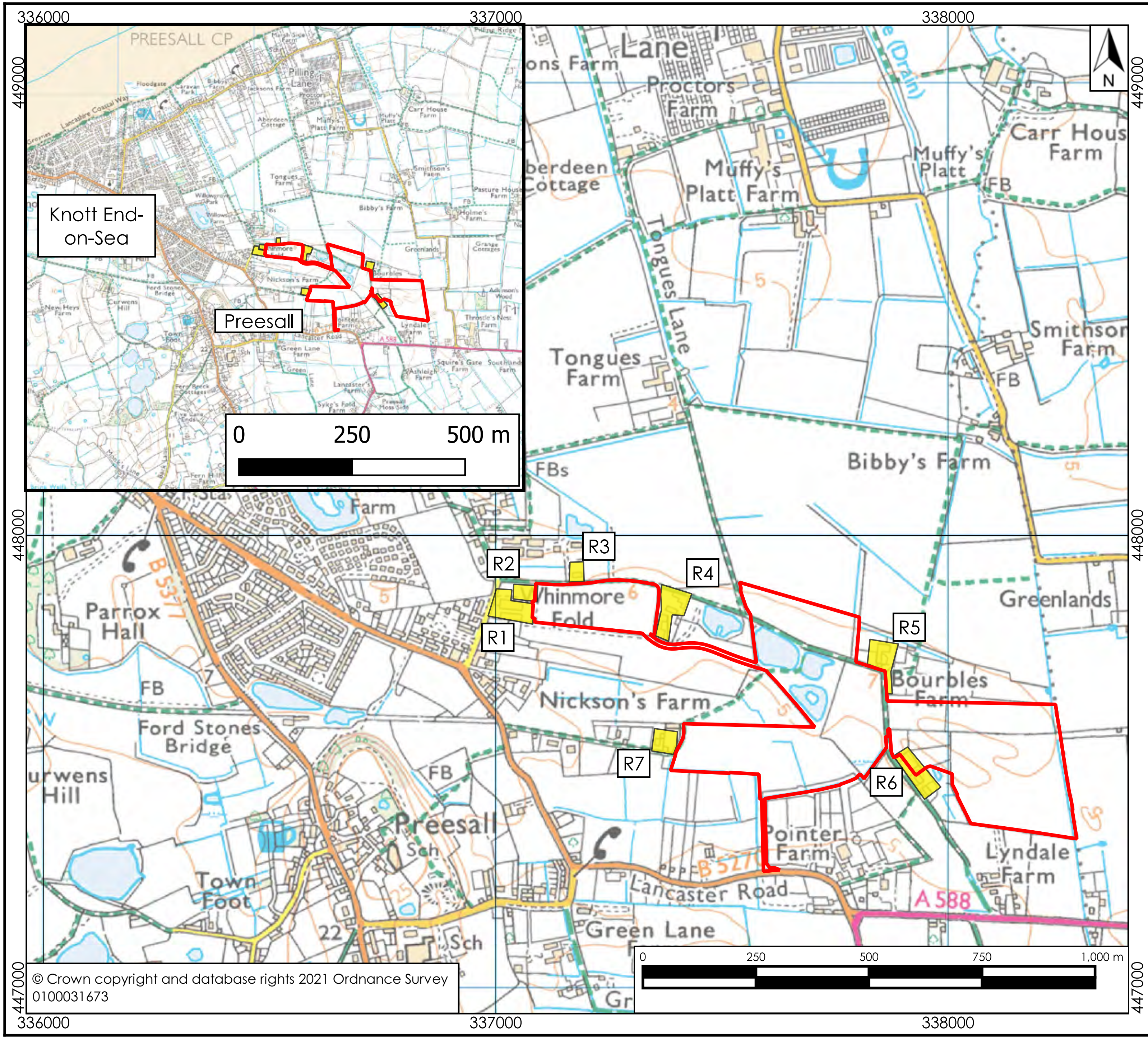
There is a potential flood risk from the site to external areas due to increased run-off from the plant area and ponding of water in working areas. This is mitigated by the depth of working areas, which provides significant buffer stormwater storage capacity to retain run-off for subsequent release to the external drainage system during all phases of development. Off-site discharge will need to take cognisance of tide levels in Morecombe Bay so that existing flooding issues due to 'tide locking' are not exacerbated. During operations any stormwater run-off to working areas and the plant area will be directed to sumps. Any excess water will be pumped at up to greenfield rates to an external field drainage network to the north of the site.

Following restoration, ground levels will be generally lower and gradients shallower than pre-development conditions. Therefore, run-off rates will be similar, if not less than greenfield conditions, and no requirement for active water management is envisaged.

The proposed drainage strategy comprising containment, infiltration and, as a last resort, discharge to an external watercourse at greenfield rates will comply with the hierarchy of acceptable measures in the Wyre Local Plan Core Development Management Policy 2 for Flood Risk and Surface Water Management. Existing flood defences and the proposed adherence to flood warning and evacuation procedures will make the site safe to work.

It is concluded that with mitigation, the development will not increase flood risk to external areas or experience flood risk that would make its operation unsafe. This assessment has demonstrated that the proposed development satisfies the flood risk requirements of the NPPF, associated technical guidance and local policy. It is considered that the development will be appropriate in terms of flood risk and that drainage can be managed effectively for the duration of extraction and post restoration.

DRAWINGS



Key

- Site Boundary
- Residential Properties

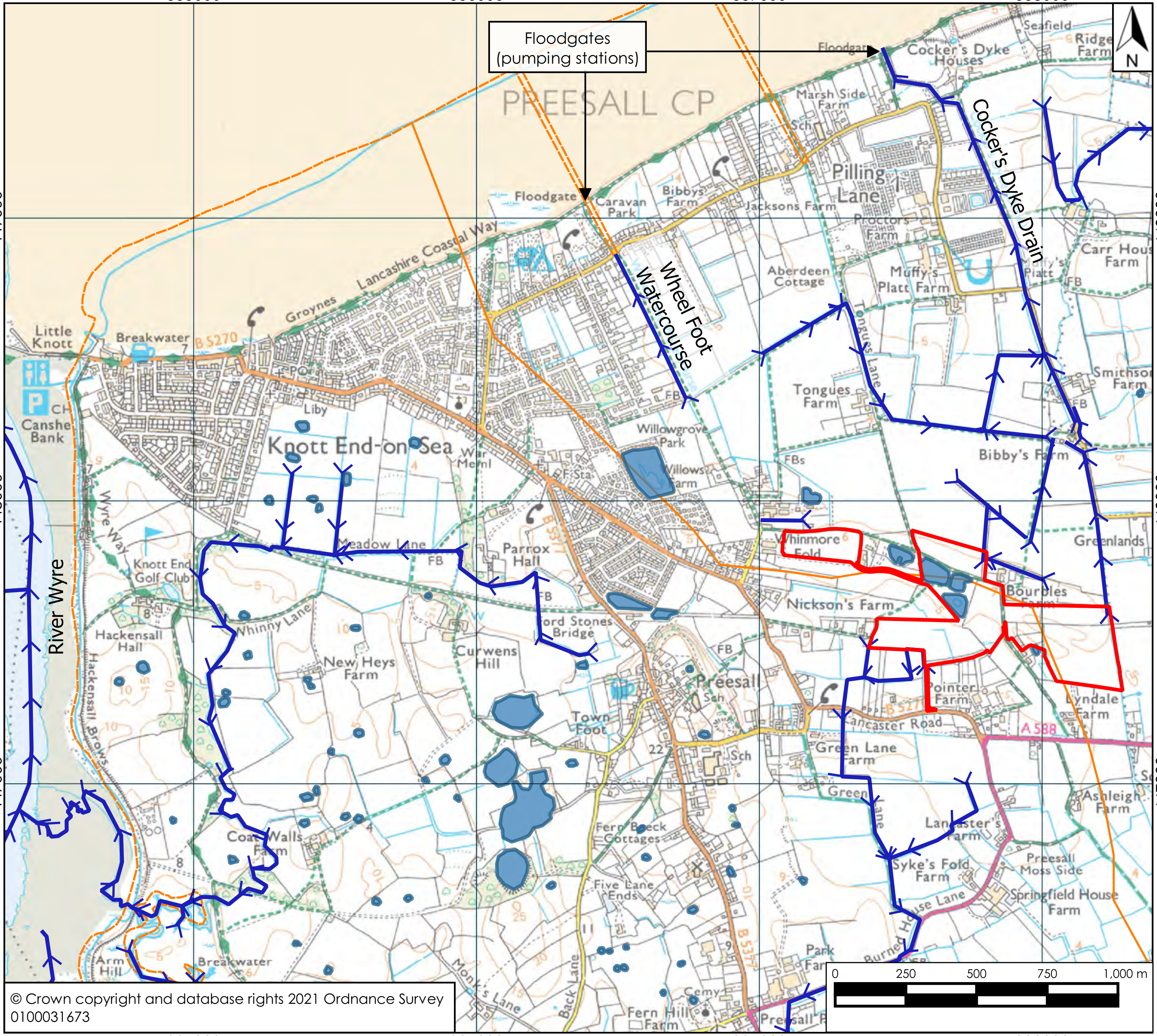
R1 = Whinmore Fold
R2 = Caravan field
R3 = Un-named property
R4 = Red Lea Dog Kennels
R5 = Bourbles Farm
R6 = New England Cottages
R7 = Un-named property (Gaulters Lane)

Scale correct at A4

Client	The Baxter Group
Title	Site Location
Project	Bourbles Farm
Drawing	3133/FRA/01
Version	1
Date	Mar 23
Scale	1:12,000

hafrenwater
environmental water management

Barkers Chambers • Barker Street • Shrewsbury • Shropshire • SY1 1SB
www.hafrenwater.com • Tel. 01743 355 770



Key

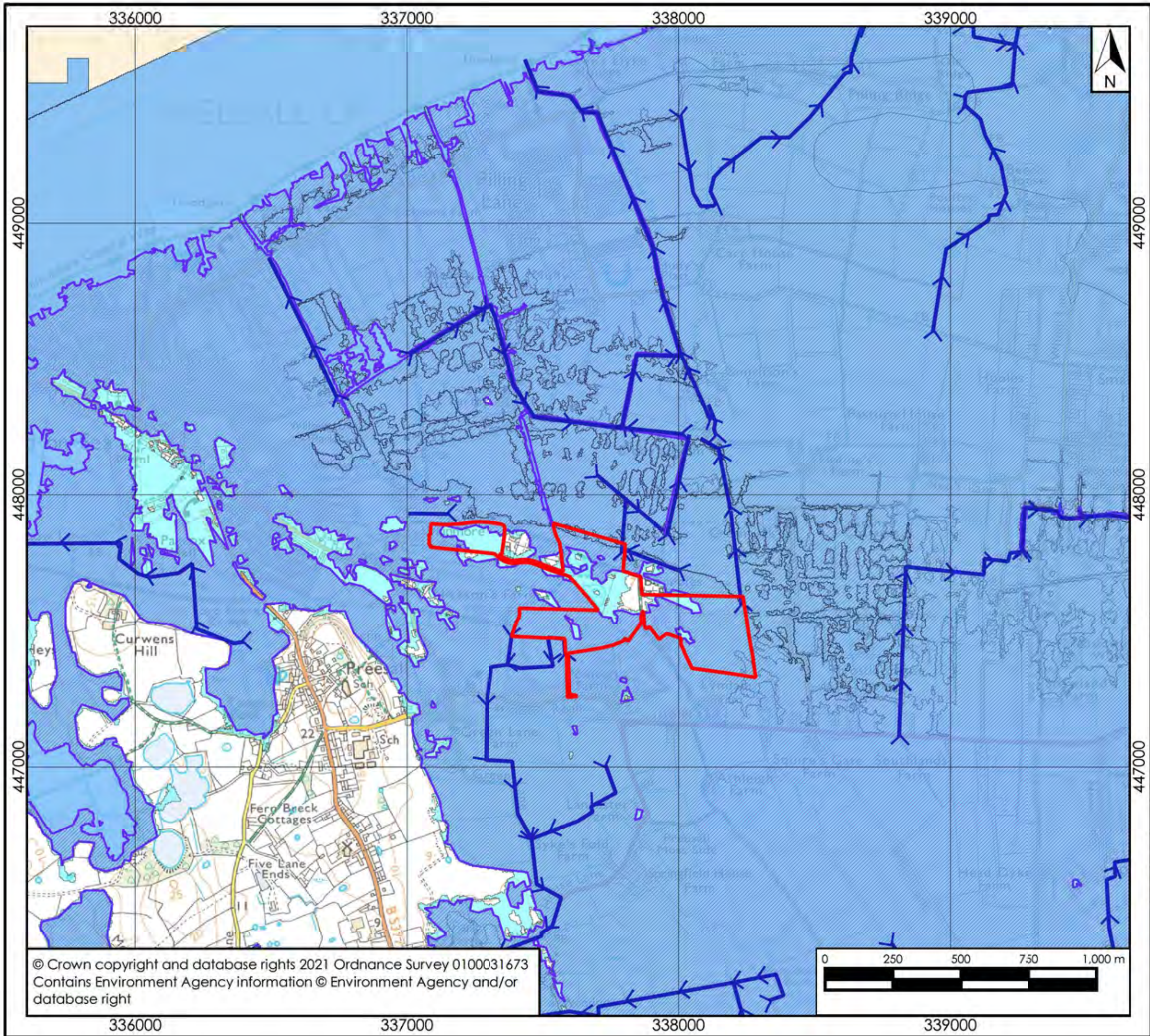
- Site Boundary
- Waterbody
- Watercourses
- Surface water catchments

Scale correct at A4

Client	The Baxter Group
Title	Water Features
Project	Bourbles Farm
Drawing	3133/FRA/02
Version	1
Date	Mar 23
Scale	1:20,000

hafrenwater
environmental water management

Barkers Chambers • Barker Street • Shrewsbury • Shropshire • SY1 1SB
www.hafrenwater.com • Tel. 01743 355 770

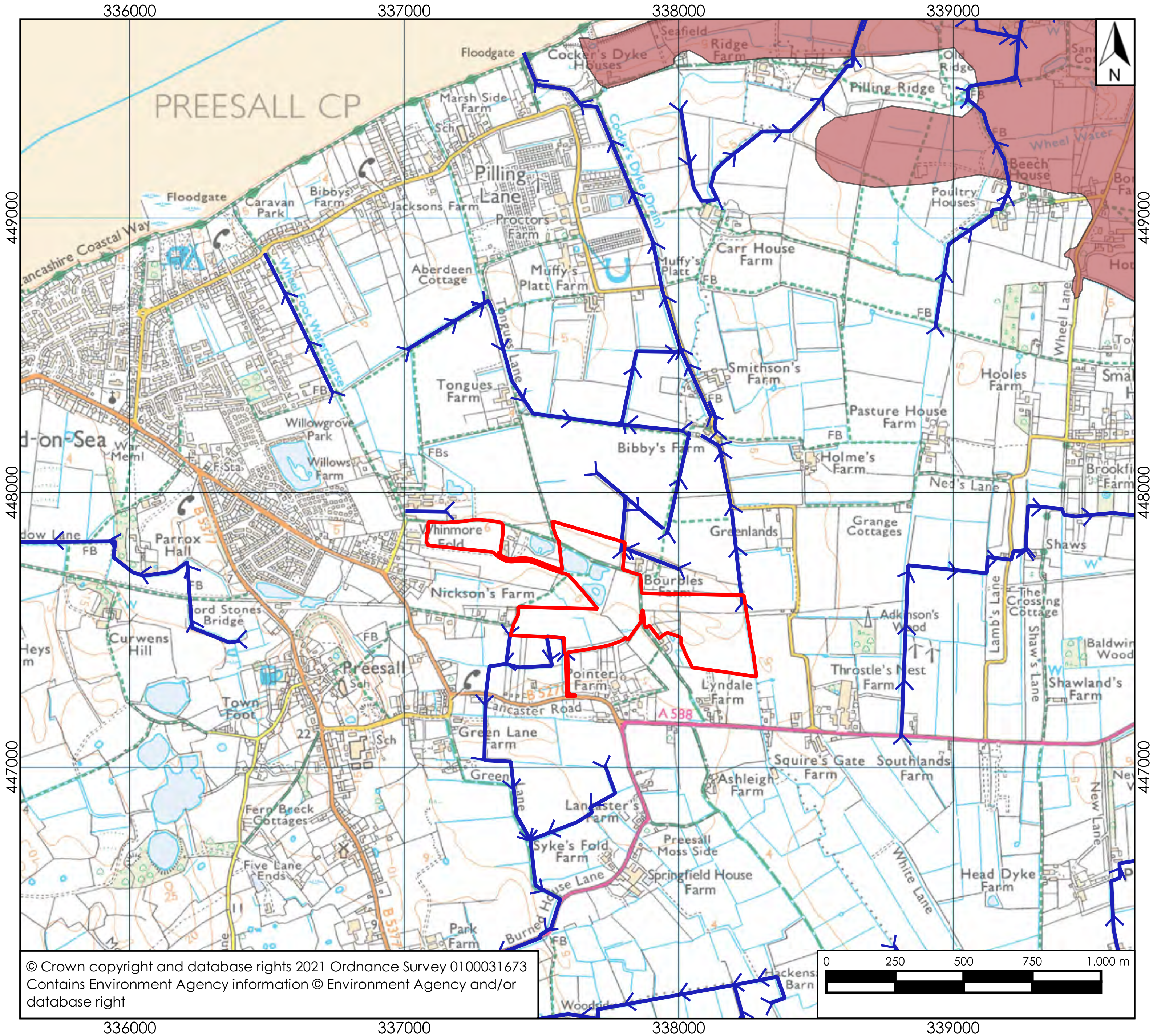


Key
- Site Boundary
- Watercourses
- Flood Zone 1
- Flood Zone 2
- Flood Zone 3
- Areas benefitting from flood defences

Scale correct at A4

Client	The Baxter Group
Title	Fluvial flood risk map
Project	Bourbles Farm
Drawing	3133/FRA/03
Version	1
Date	Mar 23
Scale	1:20,000

hafrenwater
environmental water management
Barkers Chambers • Barker Street • Shrewsbury • Shropshire • SY1 1SB
www.hafrenwater.com • Tel. 01743 355 770



Key

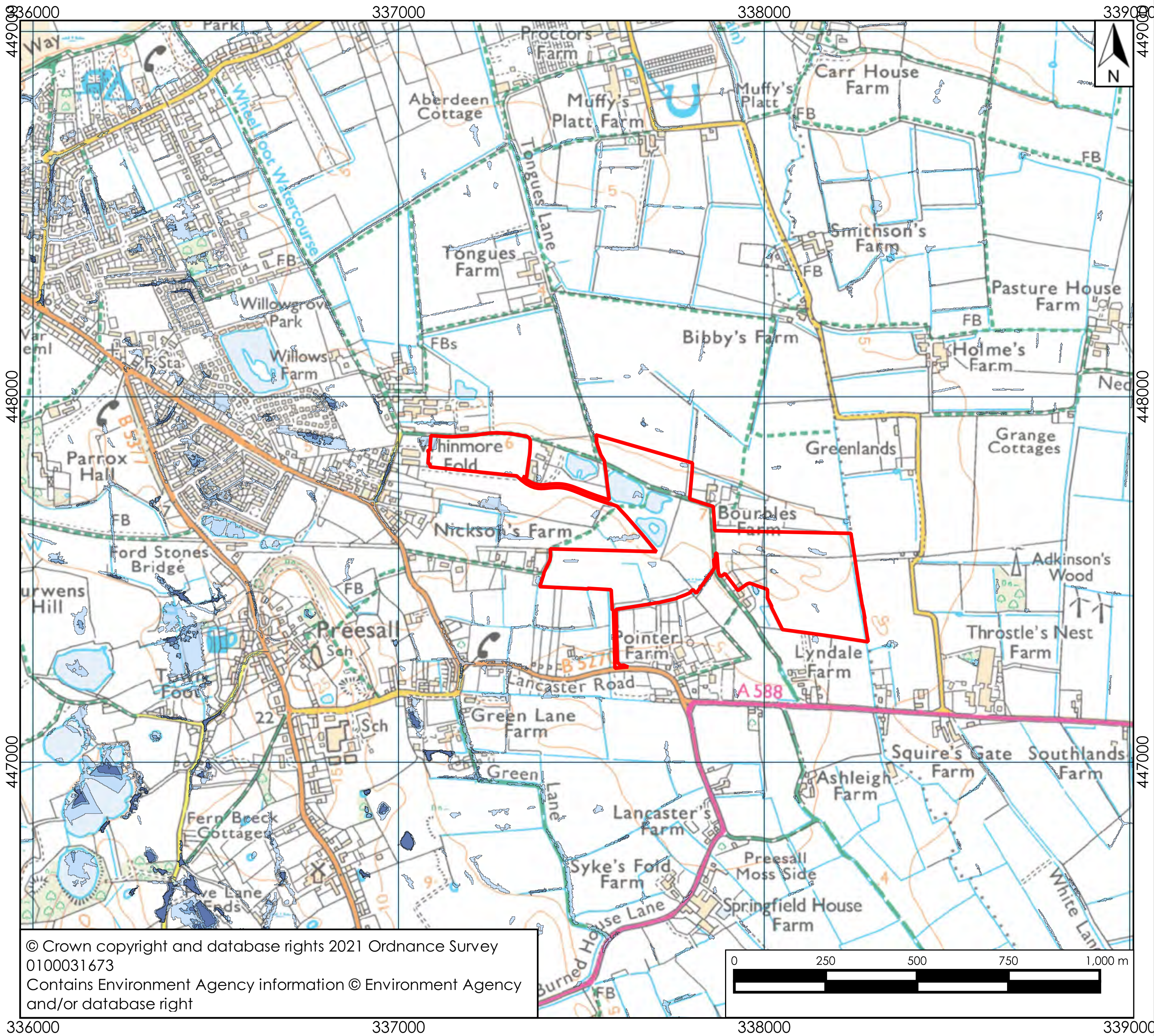
- Site Boundary
- Watercourses
- Historical flooding

Scale correct at A4

Client	The Baxter Group
Title	Historical flood risk map
Project	Bourbles Farm
Drawing	3133/FRA/04
Version	1
Date	Mar 23
Scale	1:20,000

hafrenwater
environmental water management

Barkers Chambers • Barker Street • Shrewsbury • Shropshire • SY1 1SB
www.hafrenwater.com • Tel. 01743 355 770



Key

Site Boundary

EA surface water flood risk:

- High Risk (AEP >3.3%)
- Medium Risk (AEP >1%)
- Low Risk (AEP >0.1%)
- Very Low Risk (AEP <0.1%)

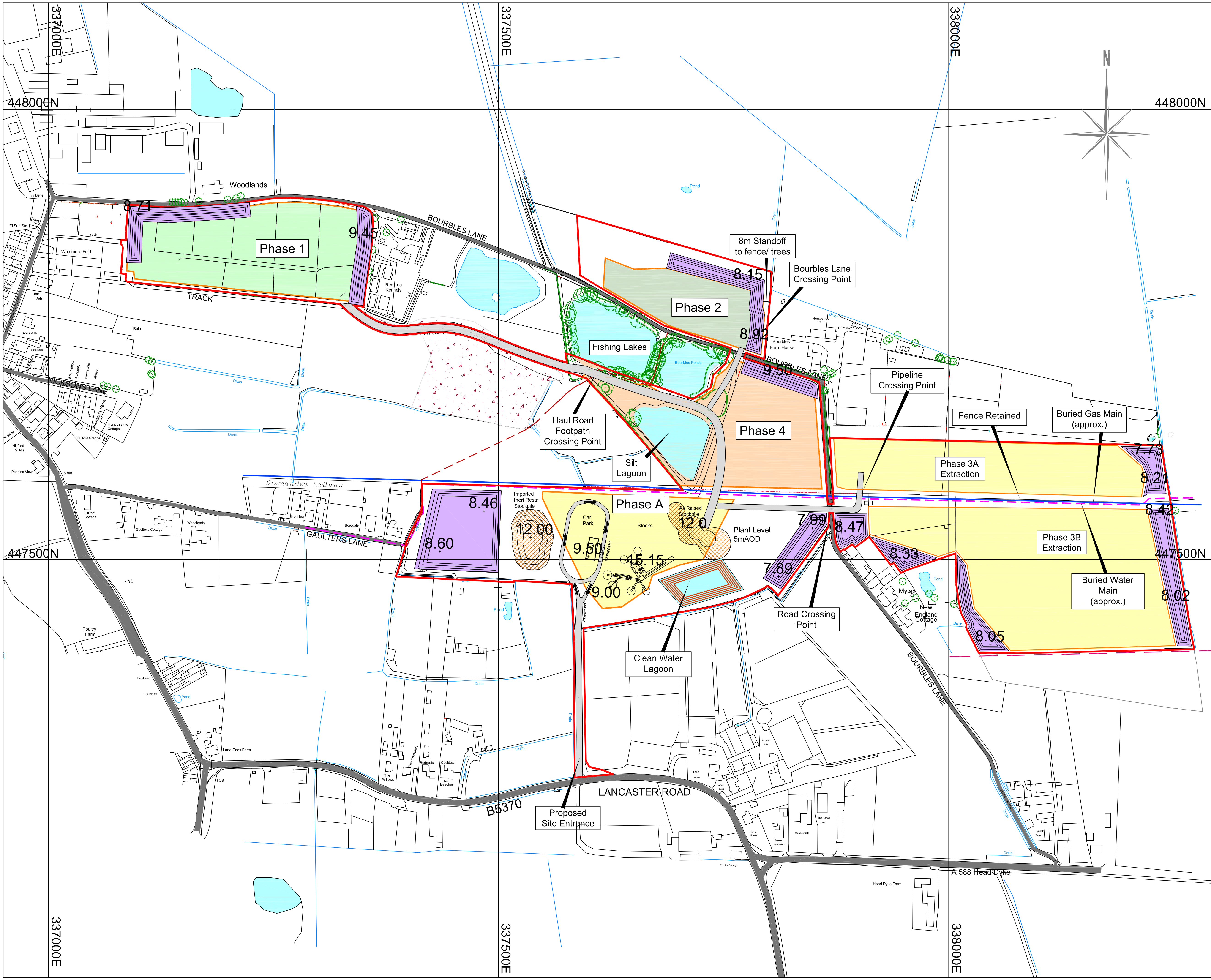
Scale correct at A4

Client	The Baxter Group
Title	Surface water flood risk map
Project	Bourbles Farm
Drawing	3133/FRA/05
Version	1
Date	Mar 23
Scale	1:15,000

hafrenwater
environmental water management
Barkers Chambers • Barker Street • Shrewsbury • Shropshire • SY1 1SB
www.hafrenwater.com • Tel. 01743 355 770

APPENDIX 3133/FRA/A1

Proposed site layout



Key

- Application Area (20.69ha)
- Water
- Buried Gas Main
- Buried Water Main
- Overhead Electric
- Bund

Scale

0m 100m 200m

Site surveyed by Greenfield Environmental May 2023
Based upon 2021 Ordnance Survey 1:2500 digital base with the permission of The Controller of Her Majesty's Stationary Office. © Crown Copyright. Licence No. 100020505

Site

Proposed Bourbles Quarry

Project

Planning Application

Plan

Site Layout & Proposed Levels - June 2023

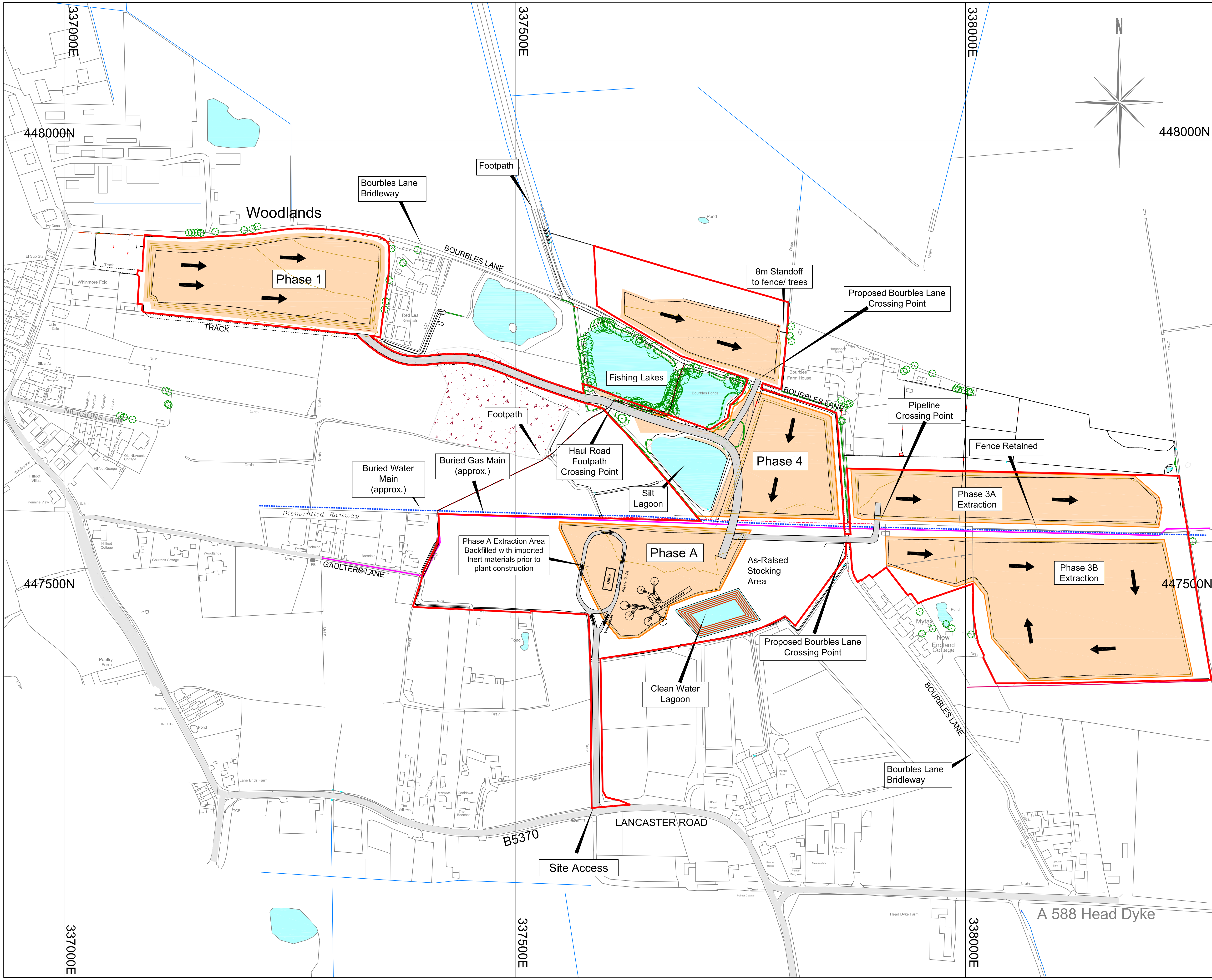
Scale:	1:4000@A3
Date:	16/06/2023
File:	BFP AppAreas+Bunds May 2023.dwg
Drawn by:	ERBM

THE BAXTER GROUP

Greenfield enviro
1 Commercial Road, Keyworth, Nottingham NG12 5JS
Email: admin@greenfieldenviro.co.uk
Tel: 0115 937 2002

APPENDIX 3133/FRA/A2

Phasing plan



Key

- Application Area
- Footpaths & Bridleway
- Direction of Working
- Sand & Gravel Extraction Areas

0m 100m 200m

Site
Proposed Bourbles Quarry

Project
Planning Application

Plan
Plan PA23-4 Proposed Quarry Phasing

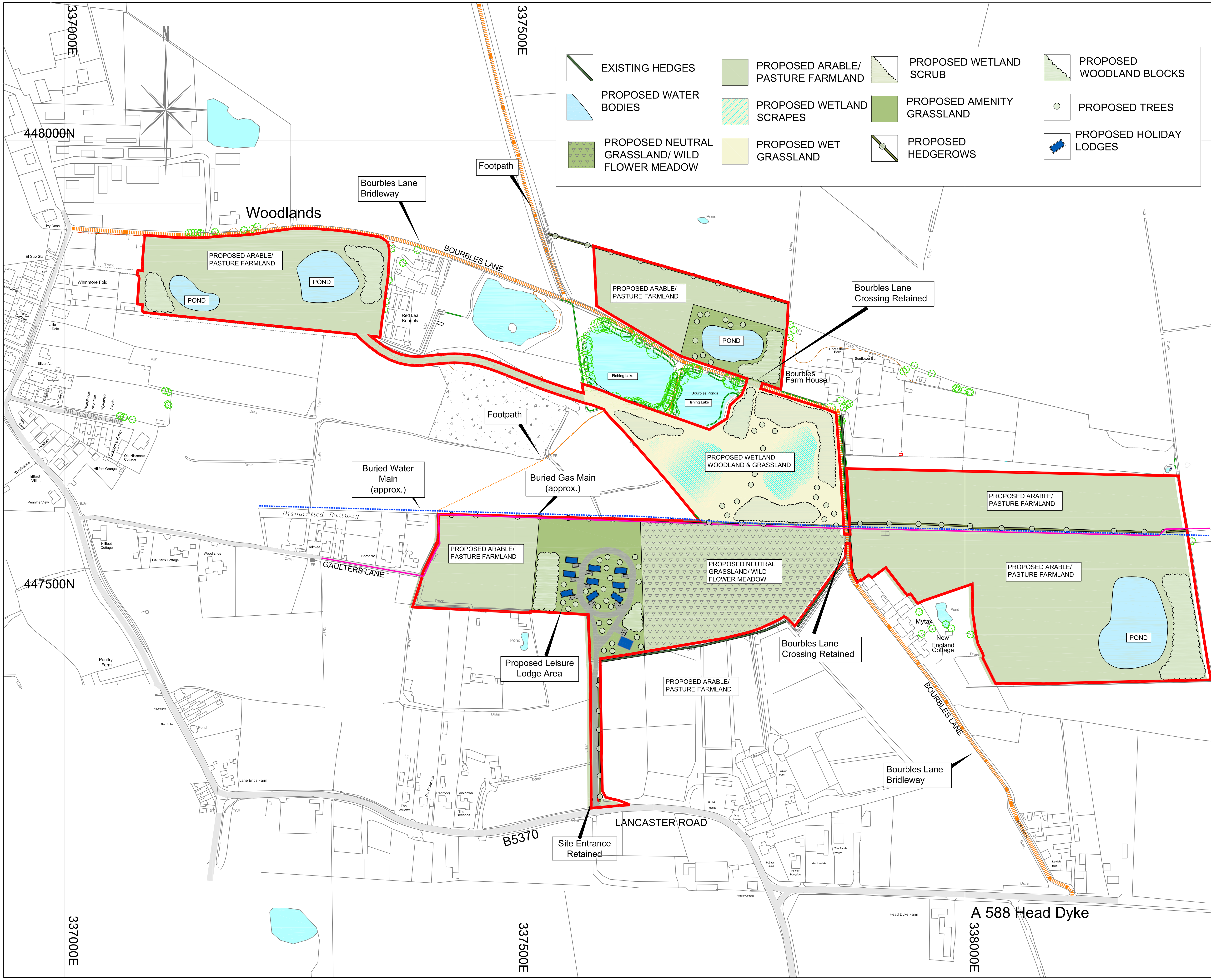
Scale:	1:4000@A3
Date:	30/06/2023
File:	PlanPA23-4 Phasing
Drawn by:	SJR

THE BAXTER GROUP

Greenfield enviro
1 Commercial Road, Keyworth, Nottingham NG12 5JS
Email: admin@greenfieldenviro.co.uk
Tel: 0115 937 2002

APPENDIX 3133/FRA/A3

Restoration plan



Key

Application Area

Footpaths & Bridleway

Restoration Concept Based on Design by ReLandscape Ltd

Scale

0m 100m 200m

Site surveyed by Greenfield Associates March 2021 & May20223.
Based upon 2020 Ordnance Survey 1:2500 digital base with the permission of The Controller of Her Majesty's Stationary Office. © Crown Copyright. Licence No. 100020505

Site
Proposed Bourbles Quarry

Project
Planning Application

Plan
Plan PA23-9 Conceptual Restoration

Scale: 1:4000@A3
Date: 17/07/2023
File: PlanPA23-9 Restn
Drawn by: SJR

THE BAXTER GROUP

Greenfield enviro

1 Commercial Road, Keyworth, Nottingham NG12 5JS
Email: admin@greenfieldenviro.co.uk
Tel: 0115 937 2002

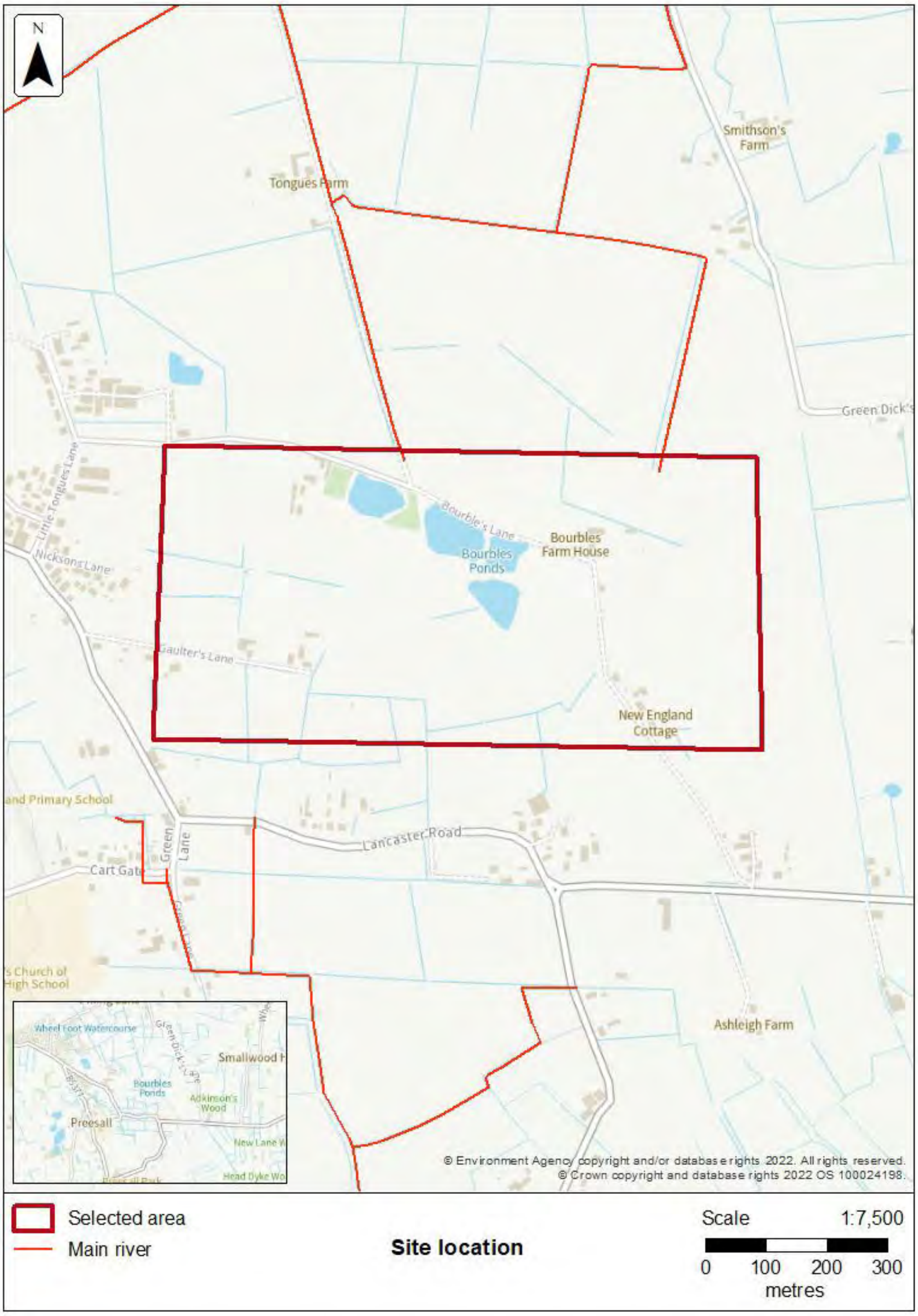
APPENDIX 3133/FRA/A4

Environment Agency Product 4

Flood risk assessment data

Location of site: 337634 / 447640 (shown as easting and northing coordinates)
Document created on: 13 December 2022
This information was previously known as a product 4.
Customer reference number: B5YC43CXYT5T

Map showing the location that flood risk assessment data has been requested for.



How to use this information

You can use this information as part of a flood risk assessment for a planning application. To do this, you should include it in the appendix of your flood risk assessment.

We recommend that you work with a flood risk consultant to get your flood risk assessment.

Included in this document

In this document you'll find:

- how to find information about surface water and other sources of flooding
- information on the models used
- definitions for the terminology used throughout
- flood map for planning (rivers and the sea)
- flood defences and attributes
- modelled data
- climate change modelled data
- information about strategic flood risk assessments
- information about this data
- information about flood risk activity permits
- help and advice

Information that's unavailable

This document **does not** contain:

- historic flooding

We do not have historic flooding data for this location.

Please note that:

- flooding may have occurred that we do not have records for
- flooding can come from a range of different sources
- we can only supply flood risk data relating to flooding from rivers or the sea

You can contact your Lead Local Flood Authority or Internal Drainage Board to see if they have other relevant local flood information. Please note that some areas do not have an Internal Drainage Board.

Surface water and other sources of flooding

Use the long term flood risk service to find out about the risk of flooding from:

- surface water
- ordinary watercourses
- reservoirs

For information about sewer flooding, contact the relevant water company for the area.

About the models used

Model name: Lune Estuary_Tidal 2014
Scenario(s): Defences removed tidal, defended climate change tidal, defences removed climate change tidal
Date: 30 July 2014

Model name: Preesall 2018
Scenario(s): Defended fluvial, defences removed fluvial, defended climate change fluvial, defences removed climate change fluvial
Date: 1 April 2018

Model name: Wyre Estuary_Tidal 2014
Scenario(s): Defences removed tidal, defended climate change tidal, defences removed climate change tidal
Date: 30 July 2014

These models contain the most relevant data for your area of interest.

Terminology used

Annual exceedance probability (AEP)

This refers to the probability of a flood event occurring in any year. The probability is expressed as a percentage. For example, a large flood which is calculated to have a 1% chance of occuring in any one year, is described as 1% AEP.

Metres above ordnance datum (mAOD)

All flood levels are given in metres above ordnance datum which is defined as the mean sea level at Newlyn, Cornwall.

Flood map for planning (rivers and the sea)

Your selected location is in flood zone 3.

Flood zone 3 shows the area at risk of flooding for an undefended flood event with a:

- 0.5% or greater probability of occurring in any year for flooding from the sea
- 1% or greater probability of occurring in any year for fluvial (river) flooding

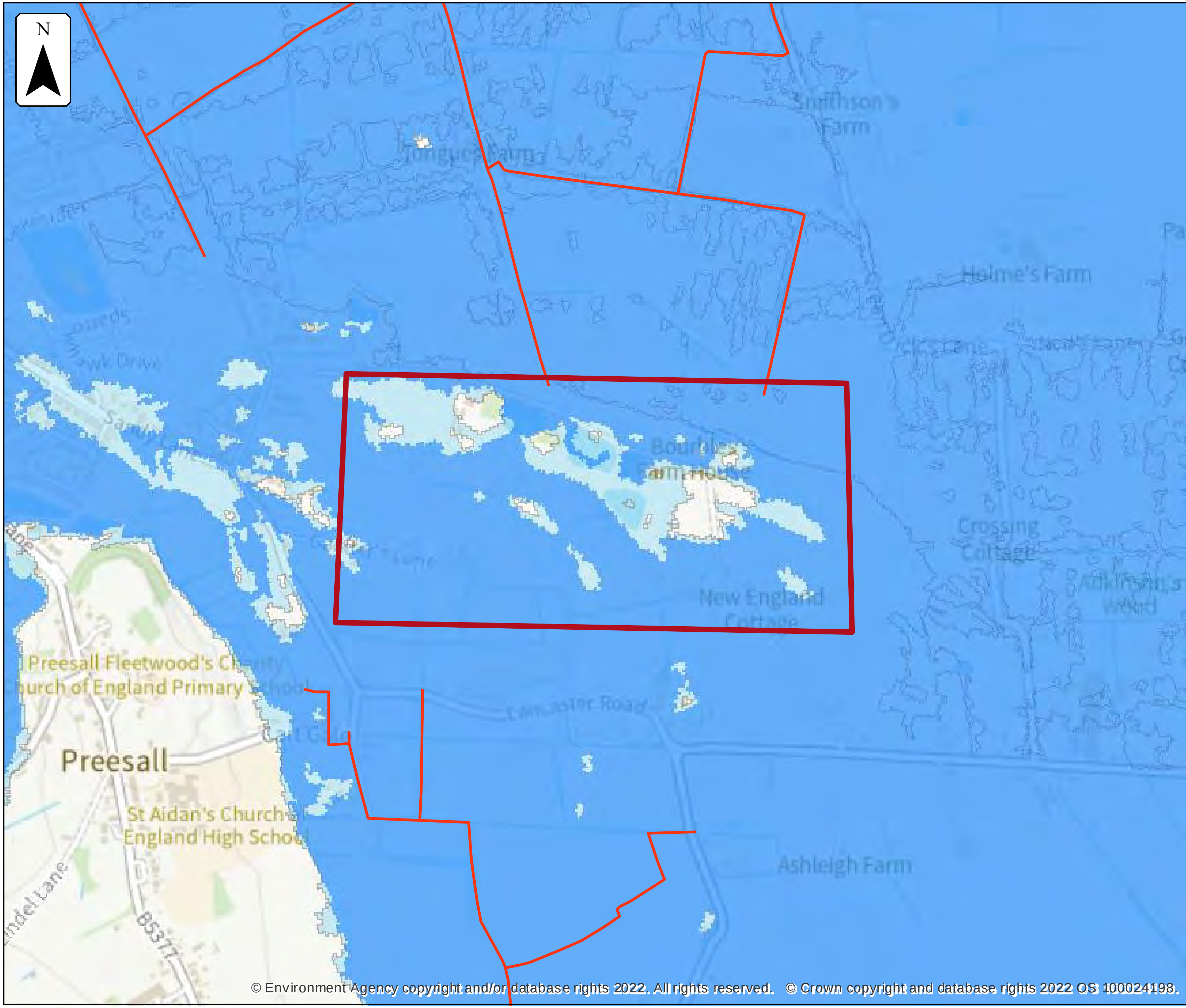
Flood zone 2 shows the area at risk of flooding for an undefended flood event with:

- between a 0.1% and 0.5% probability of occurring in any year for flooding from the sea
- between a 0.1% and 1% probability of occurring in any year for fluvial (river) flooding

It's important to remember that the flood zones on this map:

- refer to the land at risk of flooding and do not refer to individual properties
- refer to the probability of river and sea flooding, ignoring the presence of defences
- do not take into account potential impacts of climate change

This data is updated on a quarterly basis as better data becomes available.



Environment Agency

Flood map for planning

Location (easting/northing)
337634/447640

Scale
1:10,000

Created
13 Dec 2022

- Selected area
- Main river
- Flood zone 3
- Flood zone 2

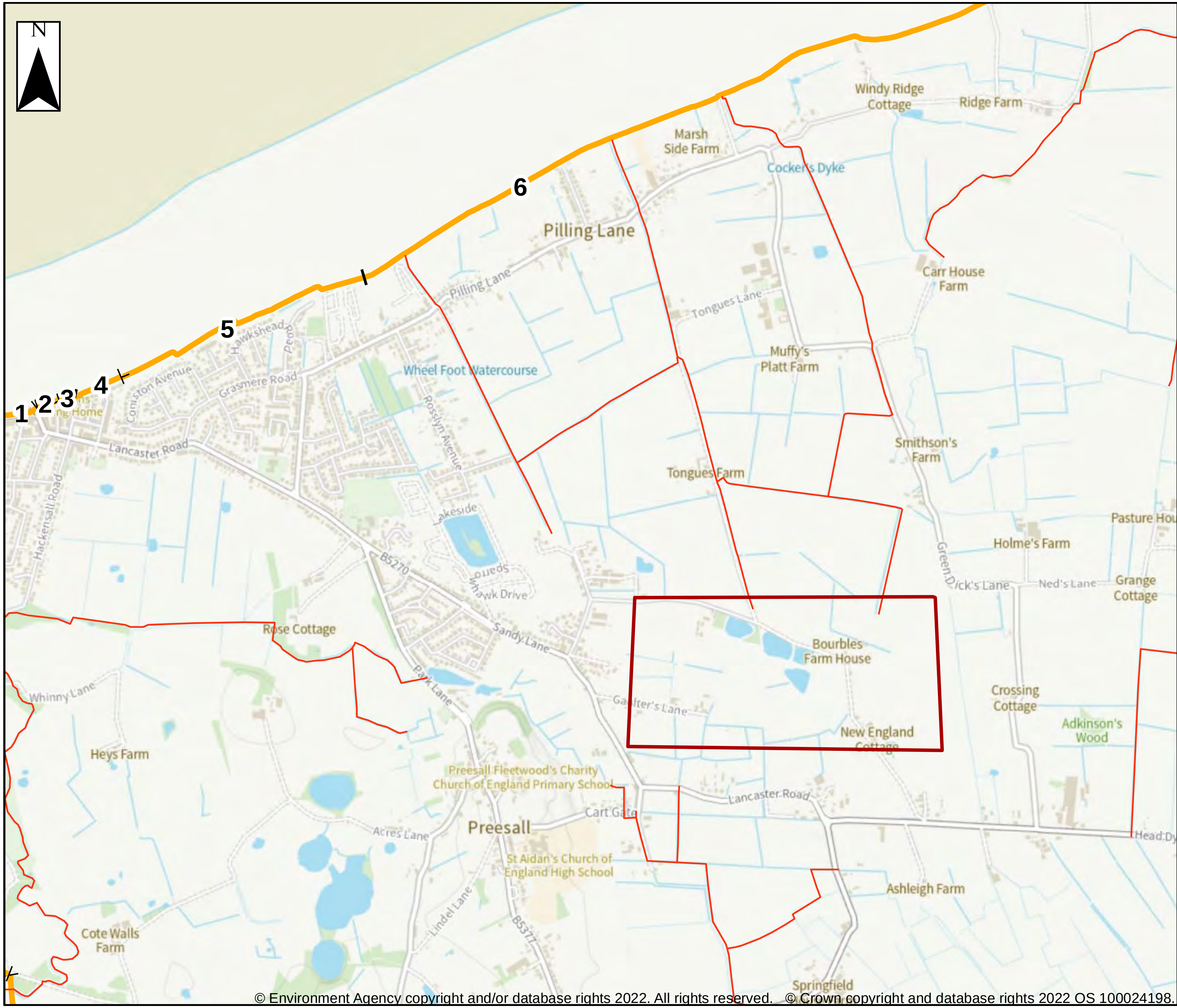
0 100 200 300 400 500
metres

Flood defences and attributes

The flood defences map shows the location of the flood defences present.

The flood defences data table shows the type of defences, their condition and the standard of protection. It shows the height above sea level of the top of the flood defence (crest level). The height is In mAOD which is the metres above the mean sea level at Newlyn, Cornwall.

It's important to remember that flood defence data may not be updated on a regular basis. The information here is based on the best available data.



Environment Agency

Flood Defences

Location (easting/northing)
337634 / 447640

Scale
1:17,004

Created
13 Dec 2022

Selected area
Main river
Flood defence

0 180 360 540 720 900
Meters

Flood defences data

Label	Asset ID	Asset Type	Standard of protection (years)	Current condition	Downstream actual crest level (mAOD)	Upstream actual crest level (mAOD)	Effective crest level (mAOD)
1	69691	Wall	200	3 - Fair	0.00	0.00	7.40
2	69216	Wall	200	3 - Fair	0.00	0.00	7.44
3	69692	Wall	200	3 - Fair	0.00	0.00	7.25
4	89399	Wall	100	3 - Fair	0.00	0.00	6.98
5	100903	Embankment	200	3 - Fair	0.00	0.00	7.61
6	138594	Embankment	200	3 - Fair	0.00	0.00	7.82

Any blank cells show where a particular value has not been recorded for an asset.

Modelled data

This section provides details of different scenarios we have modelled and includes the following (where available):

- outline maps showing the area at risk from flooding in different modelled scenarios
- modelled node point map(s) showing the points used to get the data to model the scenarios and table(s) providing details of the flood risk for different return periods
- map(s) showing the approximate water levels for the return period with the largest flood extent for a scenario and table(s) of sample points providing details of the flood risk for different return periods

Climate change

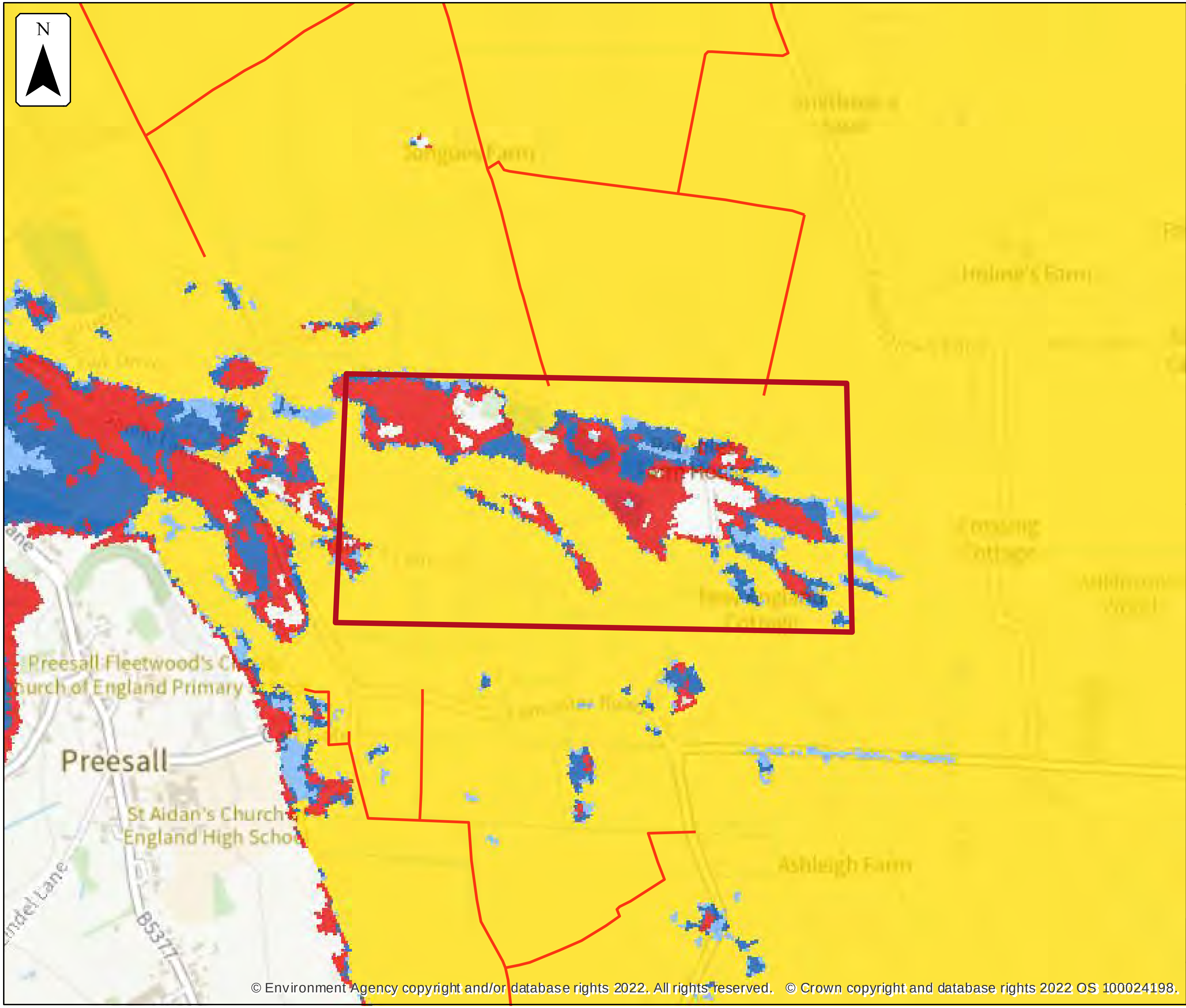
The climate change data included in the models may not include the latest flood risk assessment climate change allowances. Where the new allowances are not available you will need to consider this data and factor in the new allowances to demonstrate the development will be safe from flooding.

The Environment Agency will incorporate the new allowances into future modelling studies. For now, it's your responsibility to demonstrate that new developments will be safe in flood risk terms for their lifetime.

Modelled scenarios

The following scenarios are included:

- Defended modelled fluvial: risk of flooding from rivers where there are flood defences
- Defences removed modelled fluvial: risk of flooding from rivers where flood defences have been removed
- Defences removed modelled tidal: risk of flooding from the sea where flood defences have been removed
- Defended climate change modelled fluvial: risk of flooding from rivers where there are flood defences, including estimated impact of climate change
- Defences removed climate change modelled fluvial: risk of flooding from rivers where flood defences have been removed, including estimated impact of climate change
- Defended climate change modelled tidal: risk of flooding from the sea where there are flood defences, including estimated impact of climate change
- Defences removed climate change modelled tidal: risk of flooding from the sea where flood defences have been removed, including estimated impact of climate change



Environment Agency

Defences removed modelled tidal extent

Location (easting/northing)
337634/447640

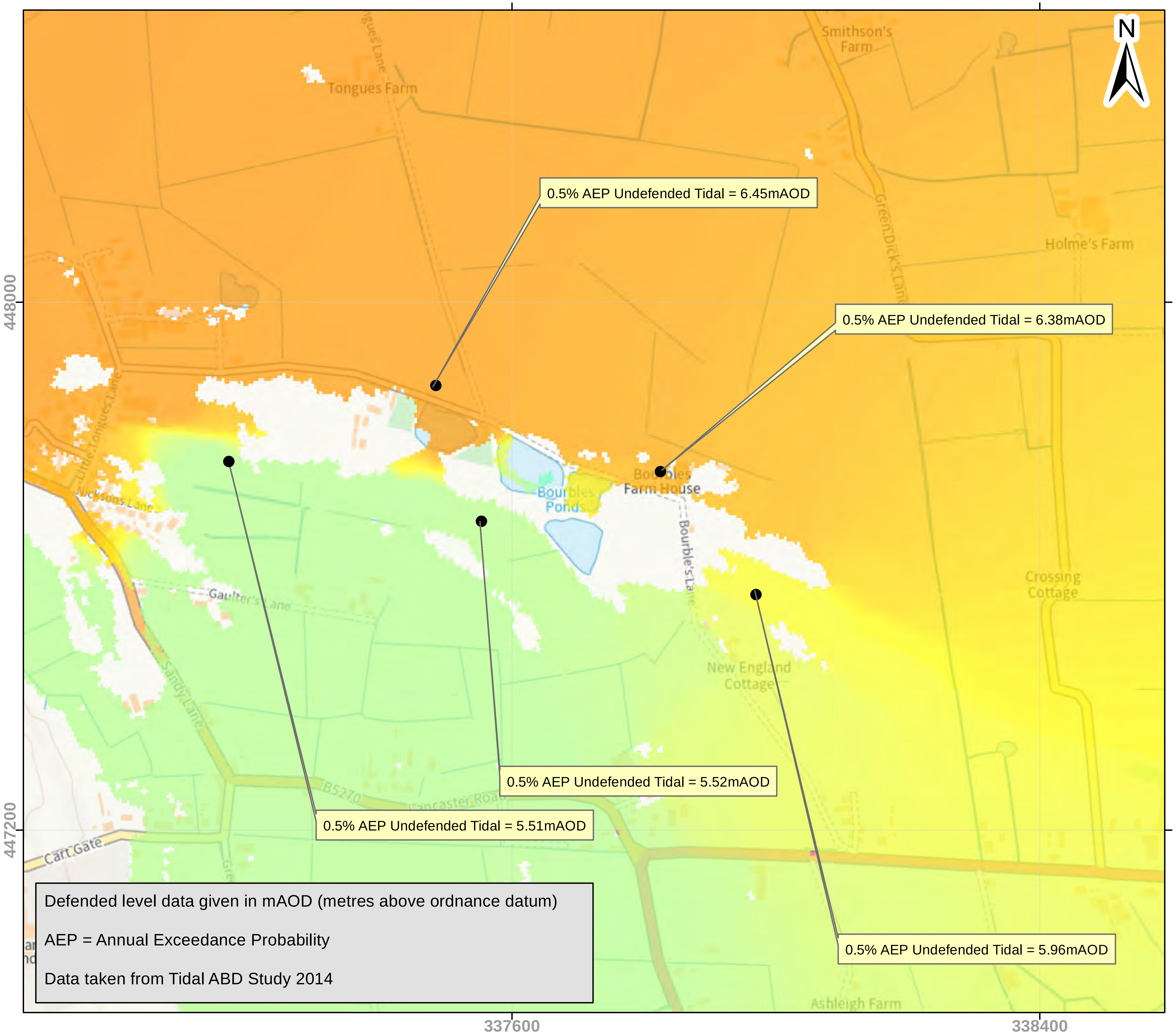
Scale	Created
1:10,000	**13 Dec 2022**

Model name
Lune Estuary Tidal 2014

Selected area
Main river
Modelled flood extent
1.33% AEP
1% AEP
0.5% AEP
0.1% AEP

Flood extents may not be visible where they overlap other return periods

0 100 200 300 400 500
metres



Environment Agency

Modelled 2d Data Map:
Bourbles Farm, Preesall,
Lancashire
Produced: 14/12/2022
Our Ref: CL286350
NGR: SD3778247617

Key

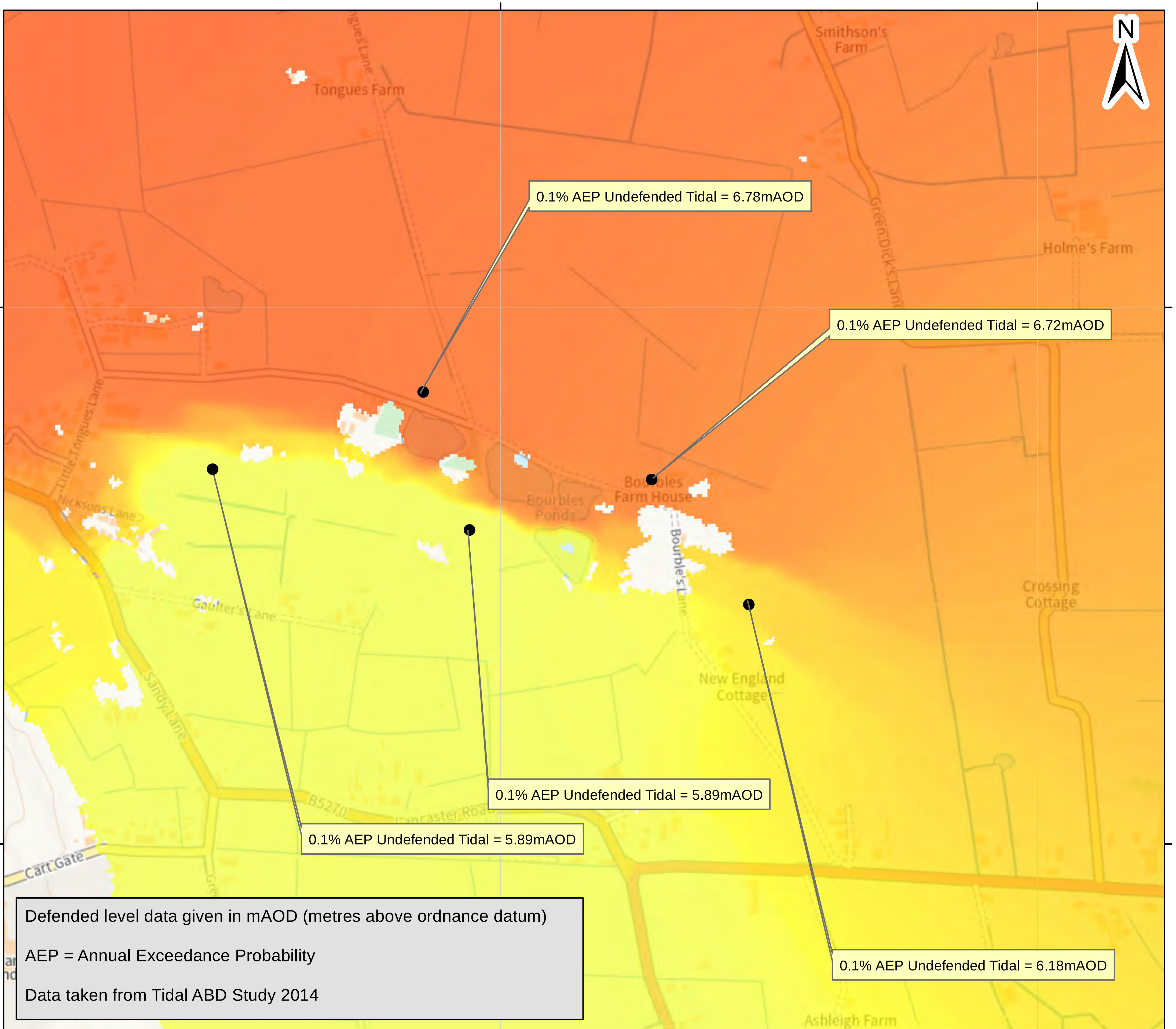
0.5% AEP Undefended Tidal Scenario

mAOD

High : 7

Low : 4

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk



Defended level data given in mAOD (metres above ordnance datum)

AEP = Annual Exceedance Probability

Data taken from Tidal ABD Study 2014

Environment Agency

Modelled 2d Data Map:
Bourbles Farm, Preesall,
Lancashire
Produced: 14/12/2022
Our Ref: CL286350
NGR: SD3778247617

Key

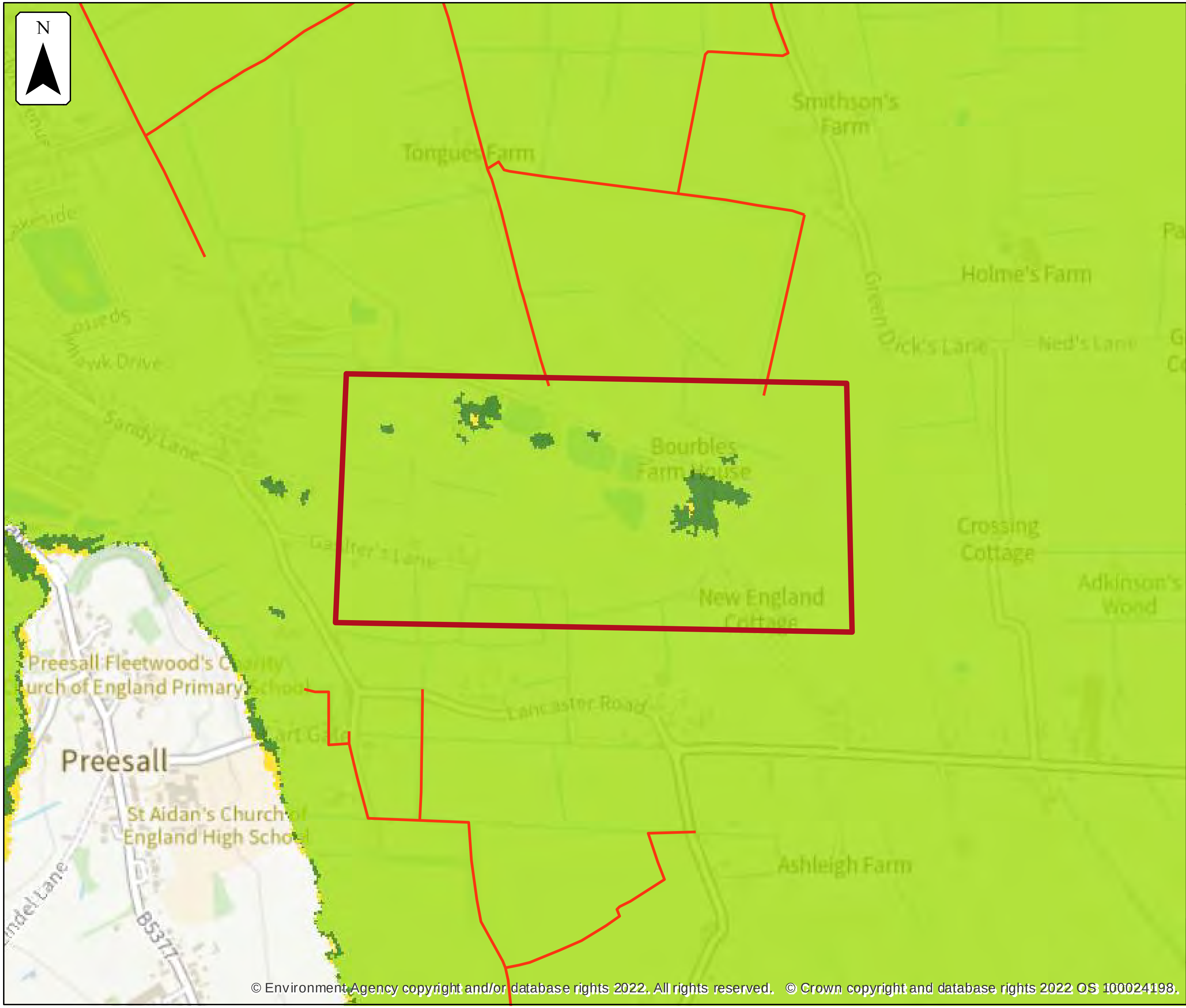
0.1% AEP Undefended Tidal Scenario

mAOD

High : 7

Low : 4

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk



Defences removed climate change modelled tidal extent

Location (easting/northing)
337634/447640

Scale **1:10,000**

Created **13 Dec 2022**

Model name
Lune Estuary Tidal 2014

Selected area

Main river

Modelled flood extent

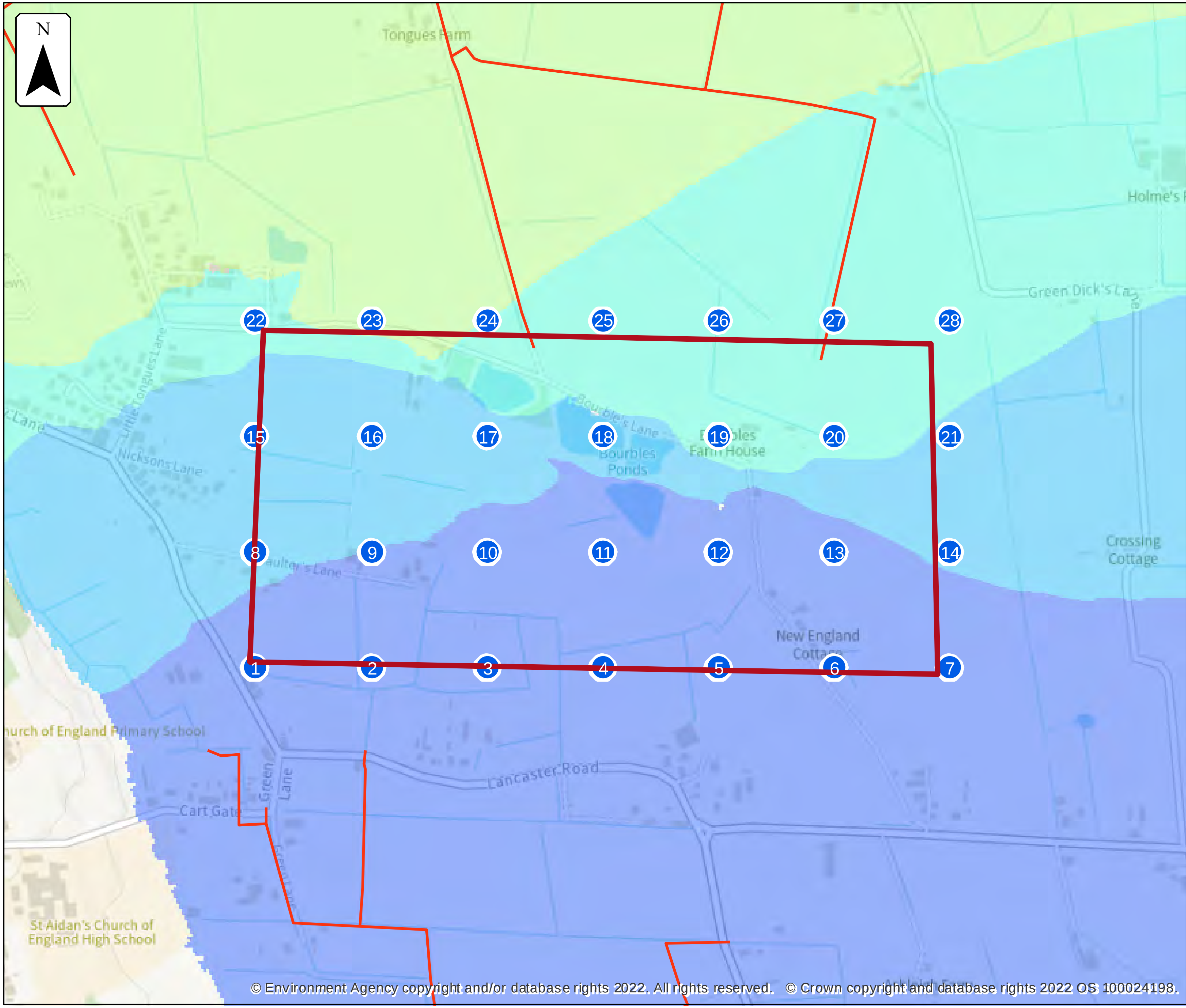
0.5% AEP (+370mm)

0.5% AEP (+670mm)

0.5% AEP (+970mm)

Flood extents may not be visible where they overlap other return periods

0 100 200 300 400 500
metres



Environment Agency

Defences removed climate change modelled tidal extent and height

Location (easting/northing)
337634/447640

Scale **1:7,500**

Created **13 Dec 2022**

Model name
Lune Estuary Tidal 2014

Selected area

Main river

Modelled 2D grid
Water level in mAOD

- 0 - 7.0
- 7.0 - 7.125
- 7.125 - 7.25
- 7.25 - 7.375
- 7.375 - 7.5
- 7.5 - 7.625
- 7.625 - 7.75
- 7.75 - 7.875
- 7.875 - 8.0

This map shows the 0.5% AEP +970mm height data

0 100 200 300
metres

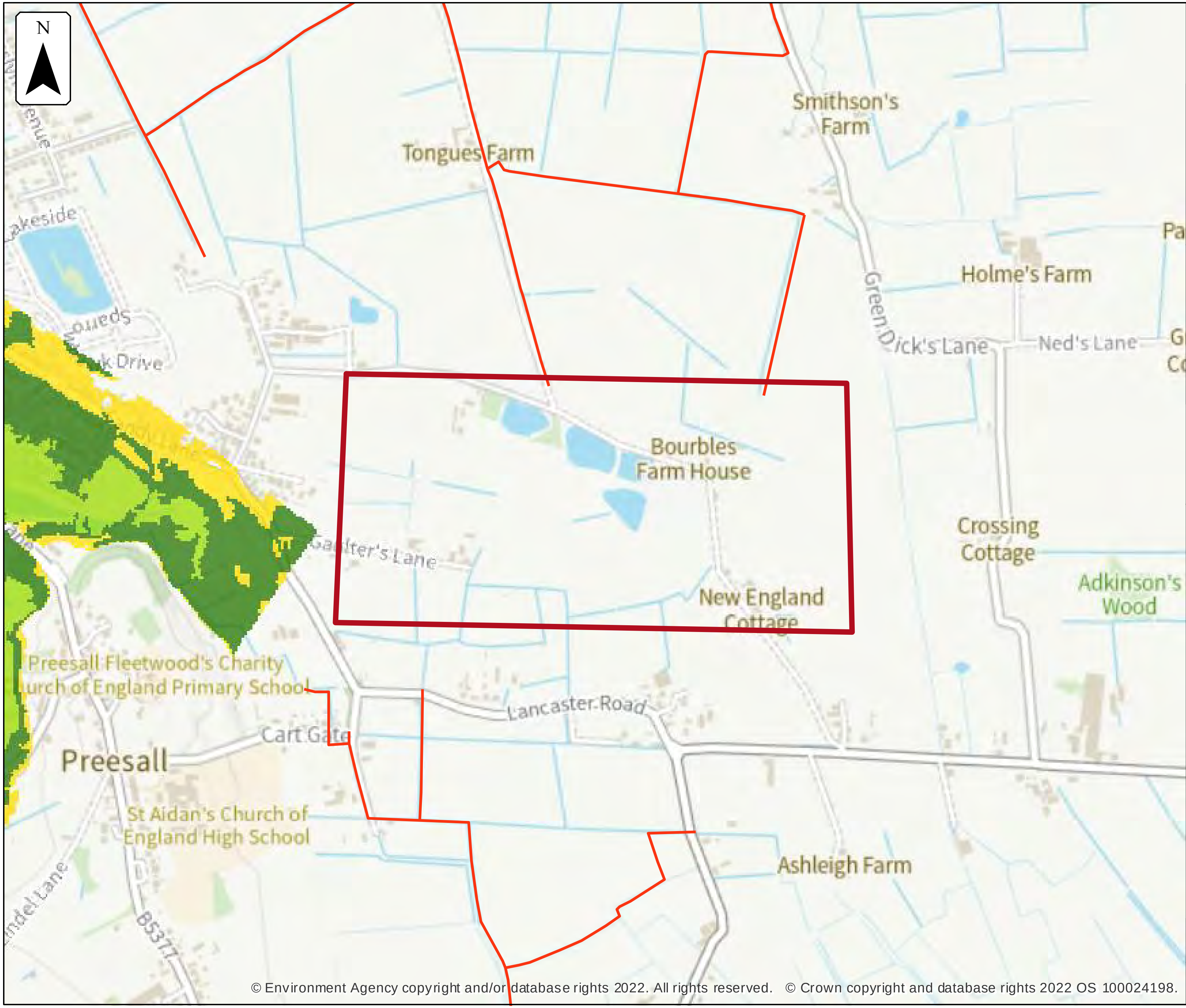
Sample point data

Defences removed climate change

Label	Easting	Northing	0.5% AEP (+370mm)		0.5% AEP (+670mm)		0.5% AEP (+970mm)	
			Depth	Height	Depth	Height	Depth	Height
1	337139	447400	0.98	6.09	1.64	6.71	2.00	7.11
2	337308	447400	1.13	6.09	1.73	6.70	2.14	7.10
3	337477	447400	1.09	6.09	1.69	6.70	2.09	7.09
4	337646	447400	0.94	6.10	1.53	6.69	1.93	7.09
5	337815	447400	0.85	6.12	1.42	6.70	1.82	7.08
6	337984	447400	1.02	6.18	1.54	6.70	1.92	7.08
7	338153	447400	0.84	6.30	1.18	6.73	1.62	7.08
8	337139	447569	0.36	6.09	1.02	6.73	1.41	7.14
9	337308	447569	1.25	6.09	1.88	6.72	2.28	7.12
10	337477	447569	1.04	6.09	1.63	6.71	2.06	7.11
11	337646	447569	0.80	6.10	1.43	6.71	1.81	7.11
12	337815	447569	0.53	6.12	1.08	6.71	1.51	7.10
13	337984	447569	0.52	6.29	1.00	6.74	1.34	7.11
14	338153	447569	1.16	6.54	1.47	6.84	1.77	7.14
15	337139	447738	1.32	6.09	1.99	6.75	2.39	7.16
16	337308	447738	0.86	6.09	1.50	6.74	1.91	7.14

Label	Easting	Northing	0.5% AEP (+370mm)		0.5% AEP (+670mm)		0.5% AEP (+970mm)	
			Depth	Height	Depth	Height	Depth	Height
17	337477	447738	0.29	6.10	0.90	6.73	1.33	7.14
18	337646	447738	1.48	6.76	1.68	7.00	1.94	7.22
19	337815	447738	0.73	6.80	0.98	7.06	1.21	7.28
20	337984	447738	1.78	6.75	2.07	7.03	2.30	7.28
21	338153	447738	1.85	6.69	2.13	6.98	2.40	7.24
22	337139	447907	1.73	6.87	2.00	7.14	2.23	7.36
23	337308	447907	1.54	6.88	1.92	7.17	2.05	7.39
24	337477	447907	1.93	6.87	2.22	7.15	2.43	7.37
25	337646	447907	1.98	6.85	2.27	7.13	2.49	7.36
26	337815	447907	2.17	6.82	2.43	7.11	2.69	7.34
27	337984	447907	2.05	6.78	2.31	7.07	2.58	7.31
28	338153	447907	1.86	6.75	2.21	7.04	2.41	7.29

Data in this table comes from the Lune Estuary Tidal 2014 model.
Height values are shown in mAOD, and depth values are shown in metres.
Any blank cells show where a particular scenario has not been modelled for this location.
Cells which contain text 'NoData' for a scenario show that return period has been modelled but there is no flood risk for that return period for that location.



Environment Agency

Defended climate change modelled tidal extent

Location (easting/northing)
337634/447640

Scale **1:10,000**

Created **13 Dec 2022**

Model name
Wyre Estuary Tidal 2014

Selected area

Main river

Modelled flood extent

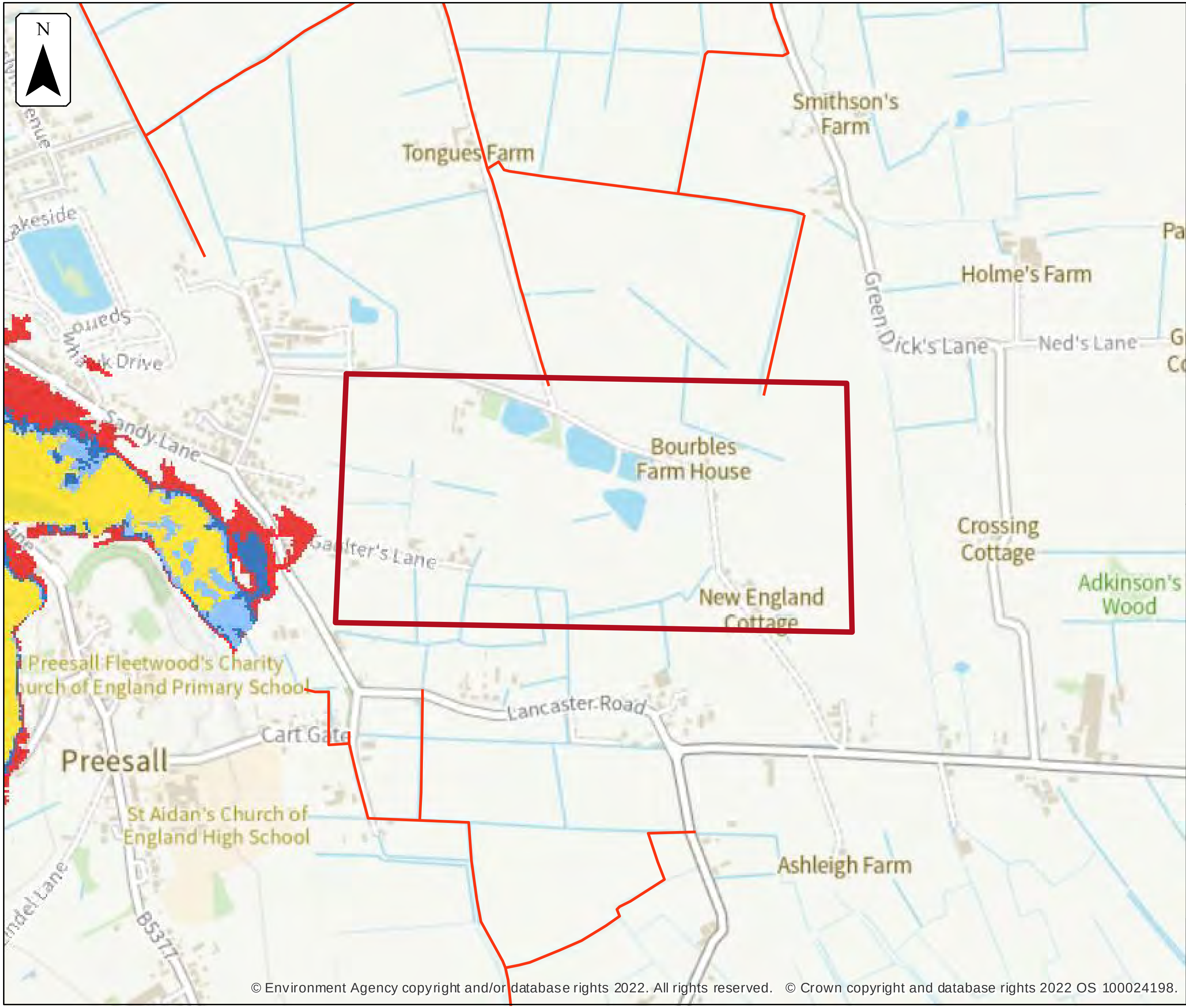
0.5% AEP (+370mm)

0.5% AEP (+670mm)

0.5% AEP (+970mm)

Flood extents may not be visible where they overlap other return periods

0 100 200 300 400 500
metres



Environment Agency

Defences removed modelled tidal extent

Location (easting/northing)
337634/447640

Scale **1:10,000**

Created **13 Dec 2022**

Model name
Wyre Estuary Tidal 2014

Selected area

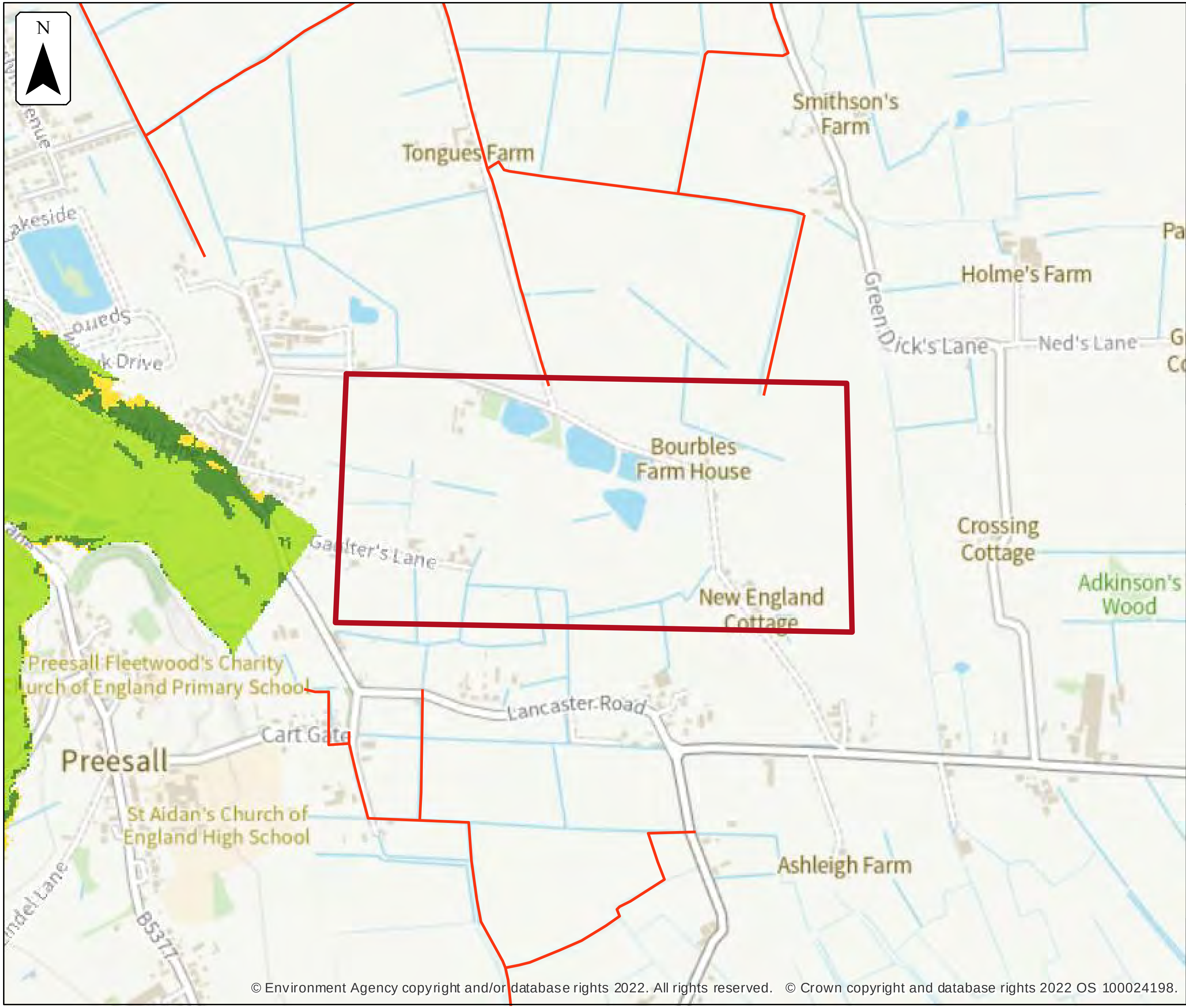
Main river

Modelled flood extent

- 1.33% AEP
- 1% AEP
- 0.5% AEP
- 0.1% AEP

Flood extents may not be visible where they overlap other return periods

0 100 200 300 400 500
metres



Environment Agency

Defences removed climate change modelled tidal extent

Location (easting/northing)
337634/447640

Scale **1:10,000**

Created **13 Dec 2022**

Model name
Wyre Estuary Tidal 2014

Selected area

Main river

Modelled flood extent

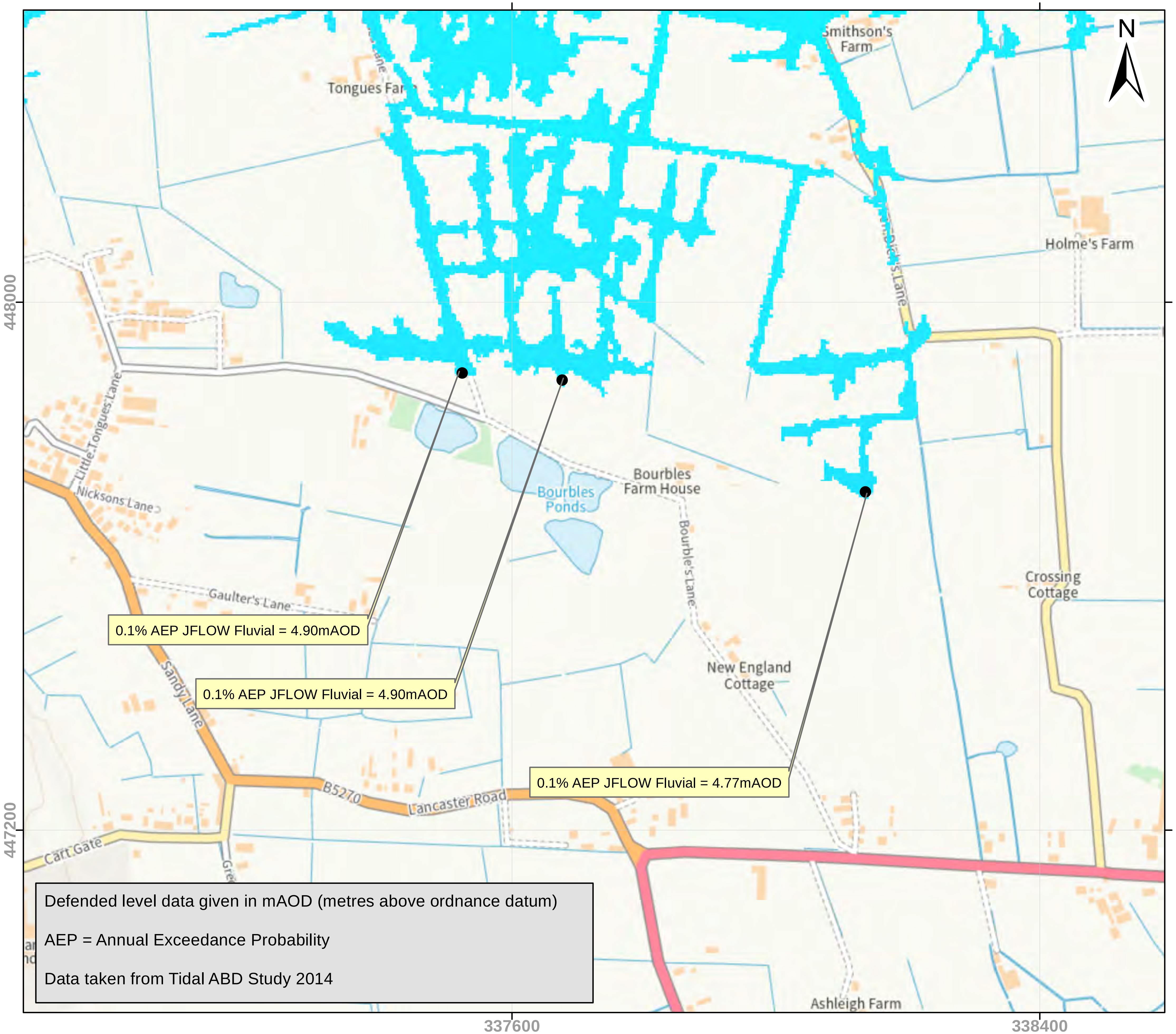
0.5% AEP (+370mm)

0.5% AEP (+670mm)

0.5% AEP (+970mm)

Flood extents may not be visible where they overlap other return periods

0 100 200 300 400 500
metres



Environment Agency

Modelled 2d Data Map:
Bourbles Farm, Preesall, Lancashire
Produced: 14/12/2022
Our Ref: CL286350
NGR: SD3778247617

Key

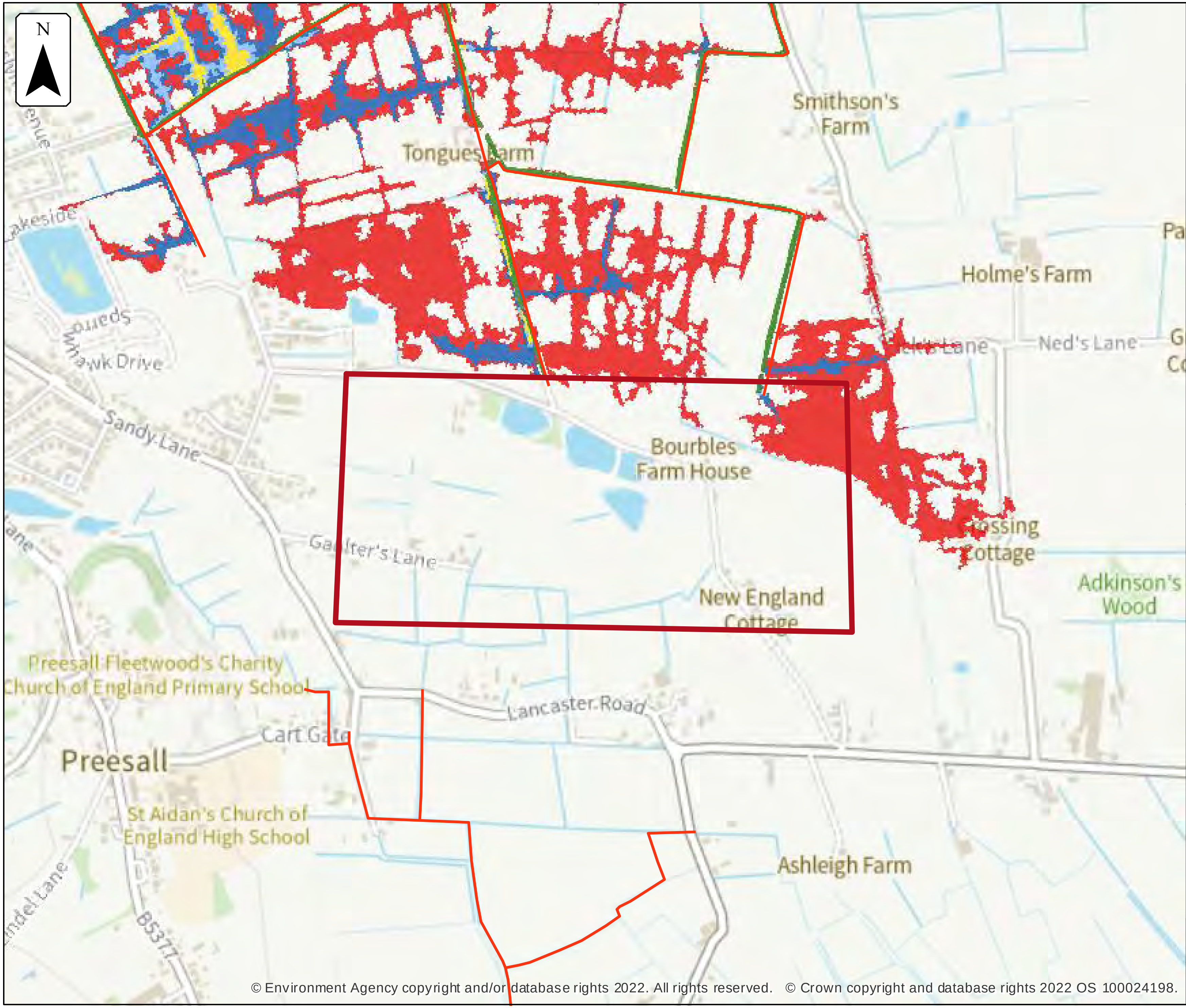
0.1% AEP JFLOW Fluvial Scenario

mAOD

High : 51.8806

Low : -2.7188

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk



Environment Agency

Defended modelled fluvial extent

Location (easting/northing)
337634/447640

Scale: **1:10,000**

Created: **13 Dec 2022**

Model name
Preesall 2018

Selected area

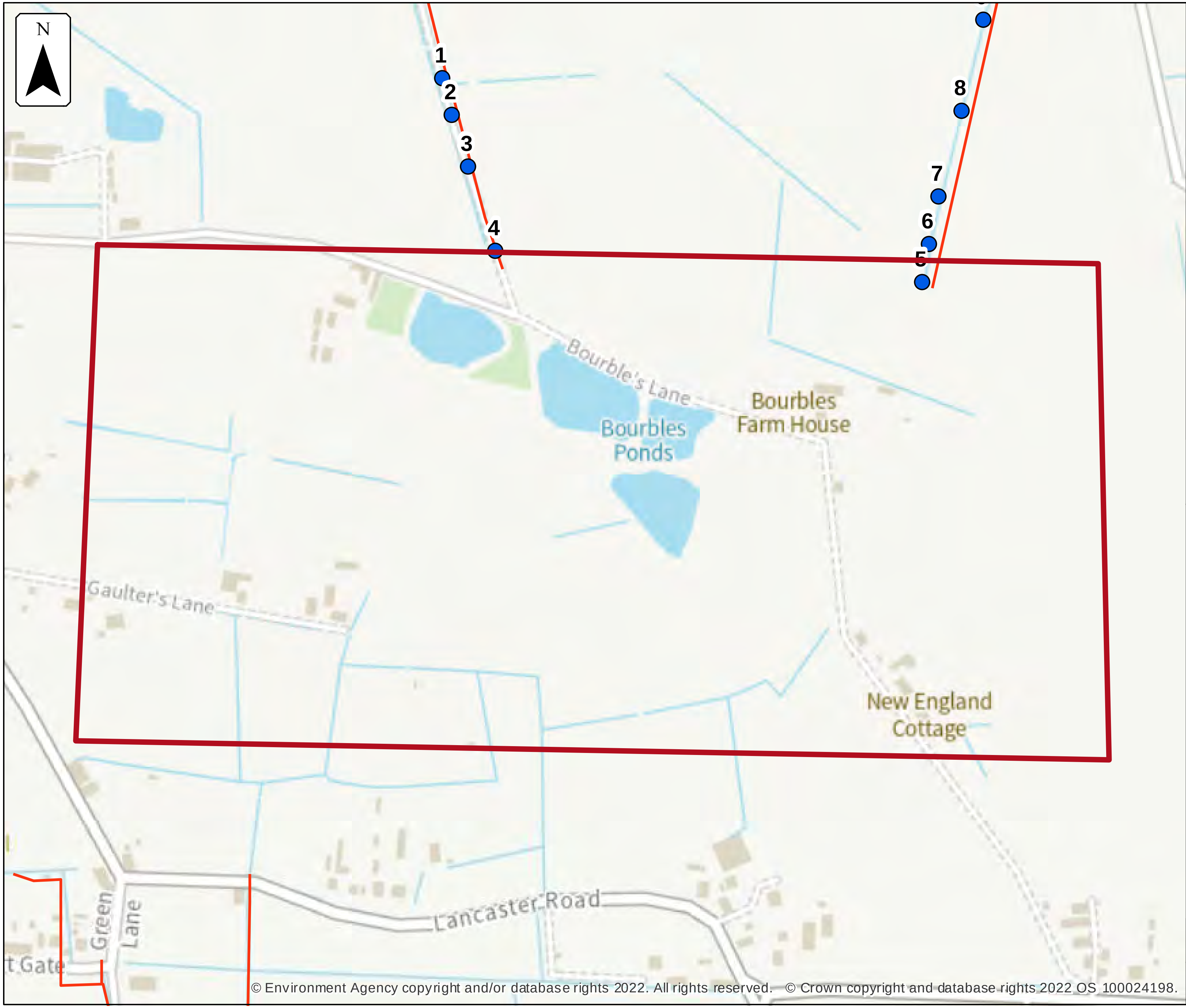
Main river

Modelled flood extent

- 2% AEP
- 1.33% AEP
- 1% AEP
- 0.5% AEP
- 0.1% AEP

Flood extents may not be visible where they overlap other return periods

0 100 200 300 400 500
metres



Environment Agency

Defended modelled fluvial node locations

Location (easting/northing)
337634/447640

Scale
1:5,000

Created
13 Dec 2022

Model name
Preesall 2018

Selected area

Modelled location

Main river

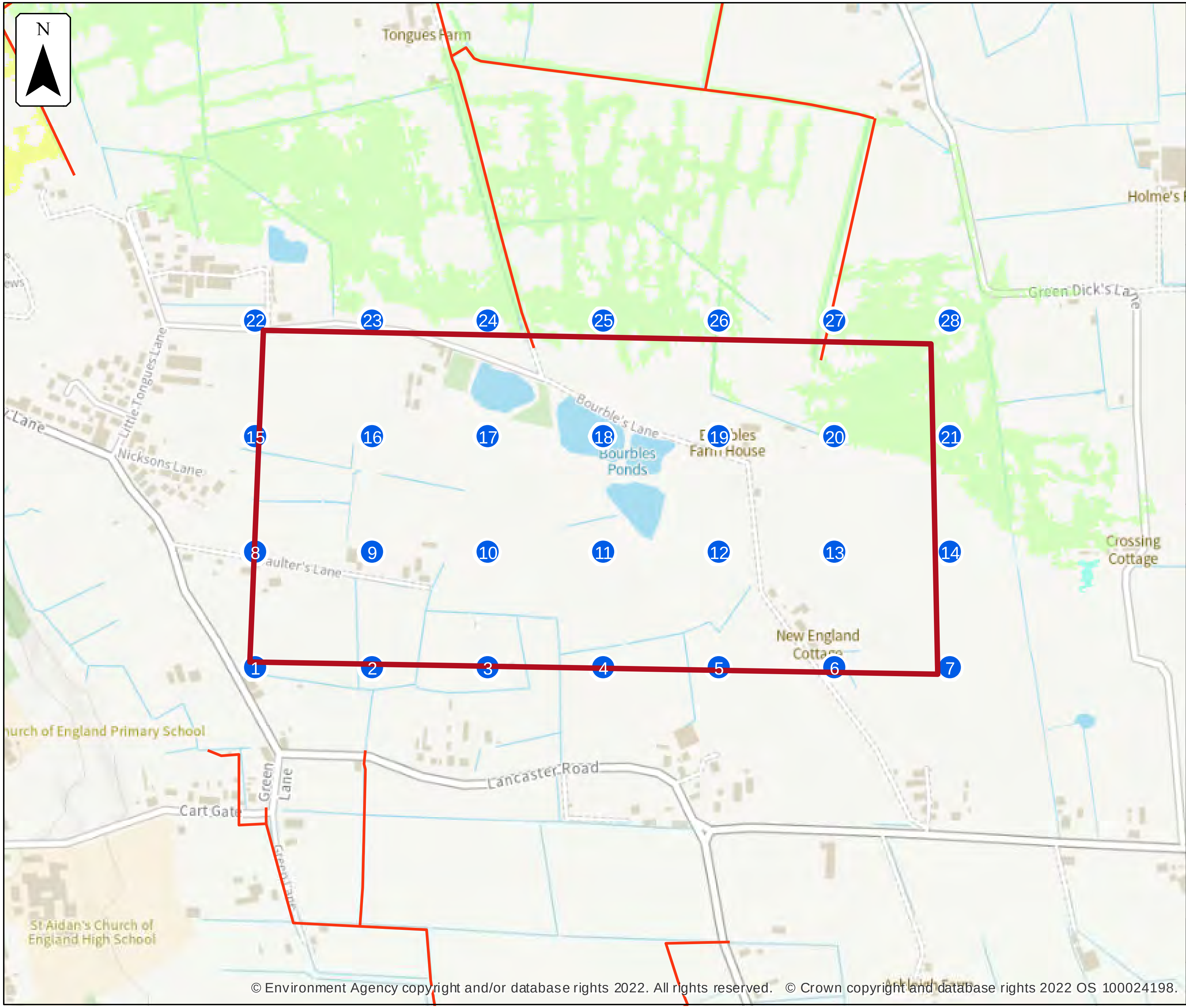
0 50 100 150 200 250
metres

Modelled node locations data

Defended

Label	Modelled location ID	Easting	Northing	5% AEP		2% AEP		1.33% AEP		1% AEP		0.5% AEP		0.1% AEP	
				Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow
1	978569	337486	448054			4.66	0.14	4.75	0.14	4.81	0.14	4.89	0.14	4.96	0.29
2	978614	337496	448018			4.67	0.12	4.75	0.12	4.81	0.12	4.89	0.13	4.98	0.13
3	978565	337511	447968			4.68	0.10	4.77	0.10	4.82	0.10	4.89	0.12	4.96	0.20
4	978642	337537	447885			4.69	0.10	4.78	0.10	4.82	0.10	4.89	0.10	4.96	0.10
5	978631	337953	447855			4.73	0.10	4.83	0.10	4.89	0.10	4.96	0.10	4.98	0.10
6	978632	337960	447891			4.73	0.10	4.83	0.10	4.89	0.10	4.96	0.10	4.98	0.10
7	978619	337970	447938			4.67	0.10	4.76	0.10	4.82	0.11	4.90	0.11	4.96	0.20
8	978577	337991	448022			4.67	0.14	4.76	0.15	4.82	0.15	4.90	0.15	4.96	0.22
9	978561	338013	448110			4.67	0.14	4.76	0.15	4.82	0.15	4.90	0.15	4.96	0.22

Data in this table comes from the Preesall 2018 model.
Level values are shown in mAOD, and flow values are shown in cubic metres per second.
Any blank cells show where a particular scenario has not been modelled for this location.



Environment Agency

Defended modelled fluvial extent and height

Location (easting/northing)
337634/447640

Scale
1:7,500

Created
13 Dec 2022

Model name
Preesall 2018

Selected area

Main river

Modelled 2D grid

Water level in mAOD

- 0 - 4.0
- 4.0 - 4.25
- 4.25 - 4.5
- 4.5 - 4.75
- 4.75 - 5.0
- 5.0 - 5.25
- 5.25 - 5.5
- 5.5 - 5.75
- 5.75 - 6.0

This map shows the 0.1% AEP height data

0 100 200 300
metres

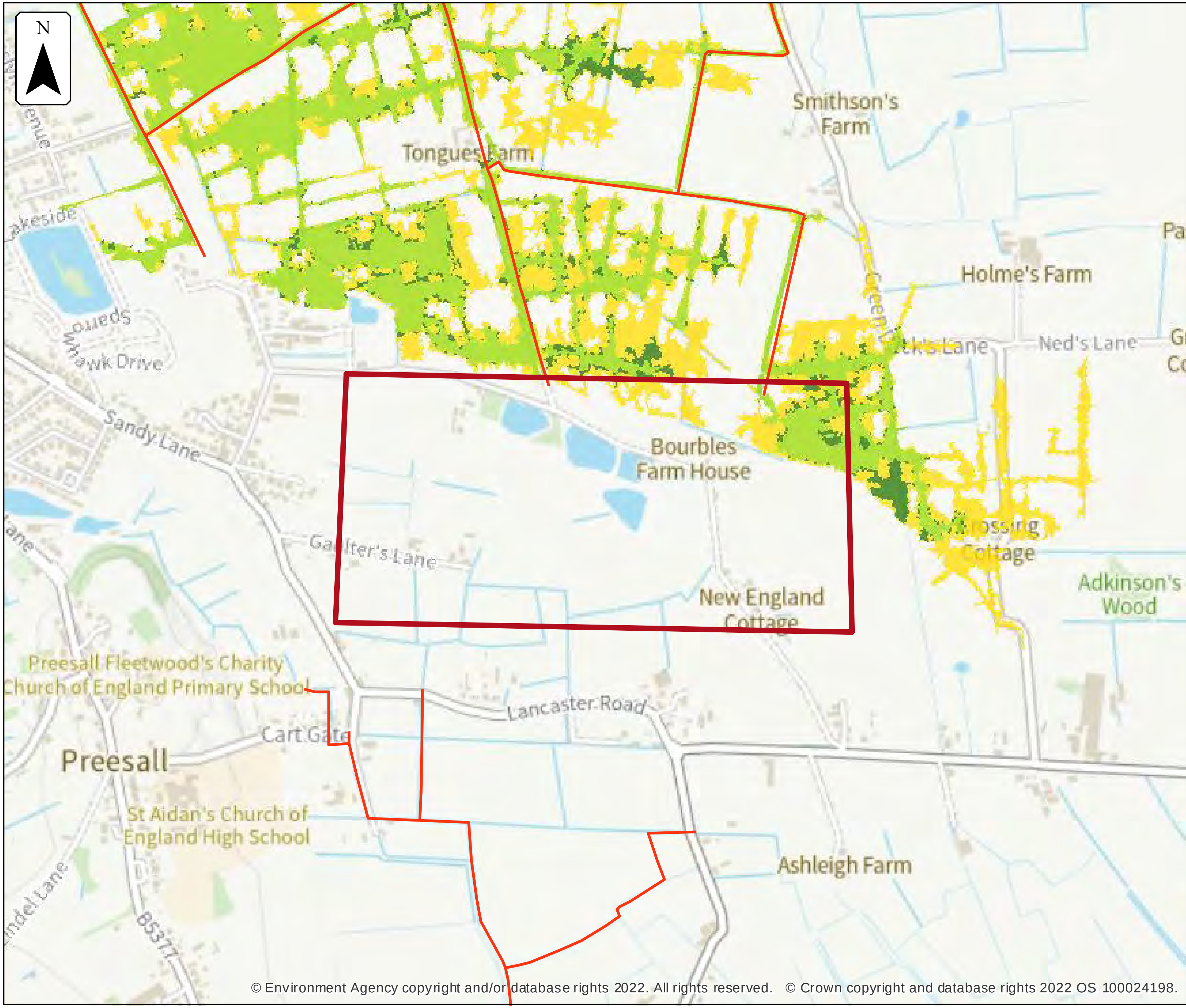
Sample point data

Defended

Label	Easting	Northing	5% AEP		2% AEP		1.33% AEP		1% AEP		0.5% AEP		0.1% AEP	
			Depth	Height	Depth	Height	Depth	Height	Depth	Height	Depth	Height	Depth	Height
1	337139	447400			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
2	337308	447400			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
3	337477	447400			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
4	337646	447400			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
5	337815	447400			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
6	337984	447400			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
7	338153	447400			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
8	337139	447569			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
9	337308	447569			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
10	337477	447569			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
11	337646	447569			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
12	337815	447569			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
13	337984	447569			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
14	338153	447569			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
15	337139	447738			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
16	337308	447738			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData

Label	Easting	Northing	5% AEP		2% AEP		1.33% AEP		1% AEP		0.5% AEP		0.1% AEP	
			Depth	Height	Depth	Height	Depth	Height	Depth	Height	Depth	Height	Depth	Height
17	337477	447738			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
18	337646	447738			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
19	337815	447738			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
20	337984	447738			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
21	338153	447738			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	0.15	4.96
22	337139	447907			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
23	337308	447907			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
24	337477	447907			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	0.05	4.96
25	337646	447907			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	0.10	4.95
26	337815	447907			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	0.27	4.95
27	337984	447907			NoData	NoData	NoData	NoData	NoData	NoData	0.02	4.77	0.20	4.96
28	338153	447907			NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	0.09	4.96

Data in this table comes from the Preesall 2018 model.
Height values are shown in mAOD, and depth values are shown in metres.
Any blank cells show where a particular scenario has not been modelled for this location.
Cells which contain text 'NoData' for a scenario show that return period has been modelled but there is no flood risk for that return period for that location.



Environment Agency

Defended climate change modelled fluvial extent

Location (easting/northing)
337634/447640

Scale **1:10,000**

Created **13 Dec 2022**

Model name
Preesall 2018

Selected area

Main river

Modelled flood extent

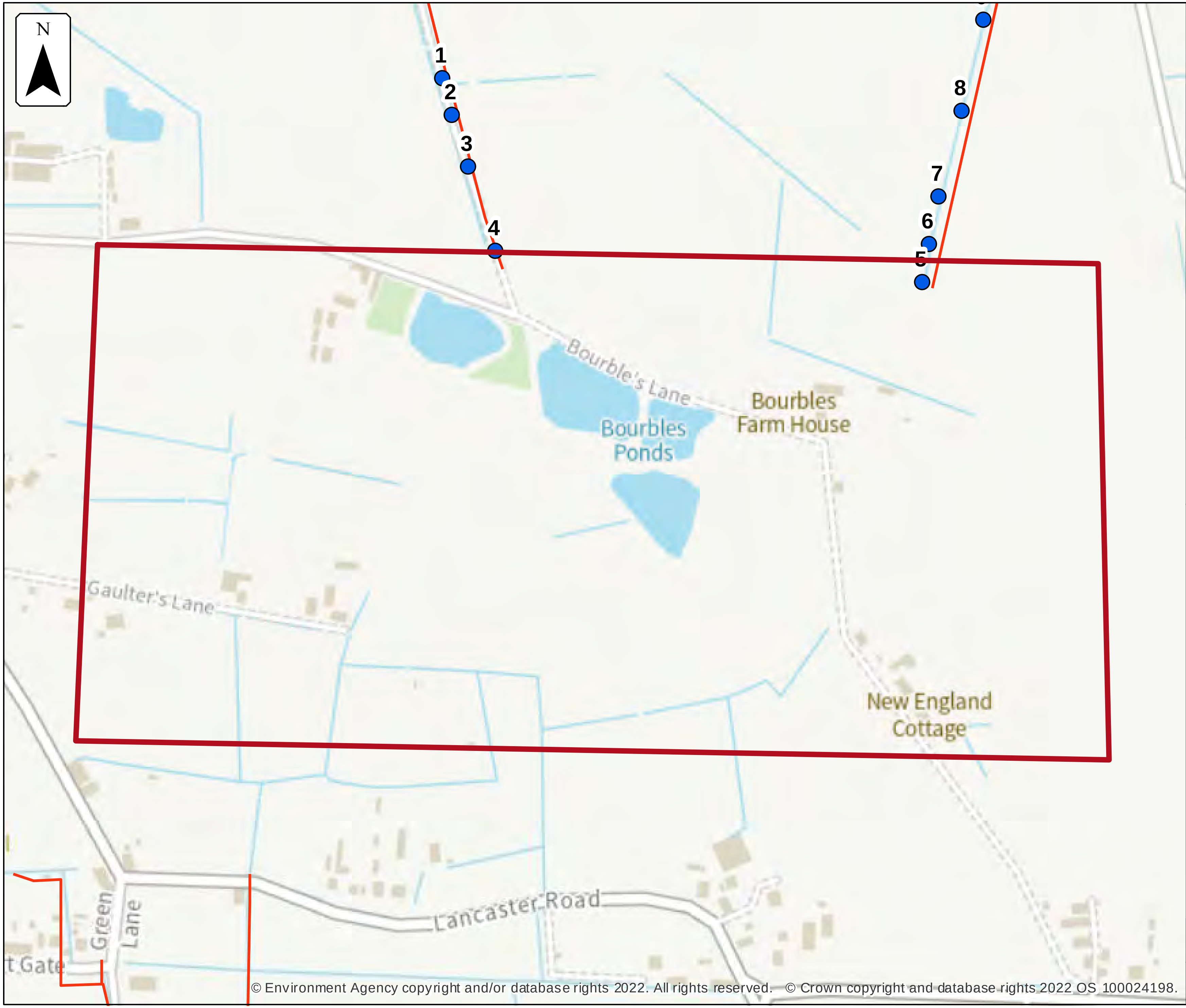
1.0% AEP (+30%)

1.0% AEP (+35%)

1.0% AEP (+70%)

Flood extents may not be visible where they overlap other return periods

0 100 200 300 400 500
metres



Defended climate change modelled fluvial node locations

Location (easting/northing)
337634/447640

Scale
1:5,000

Created
13 Dec 2022

Model name
Preesall 2018

Selected area

Modelled location

Main river

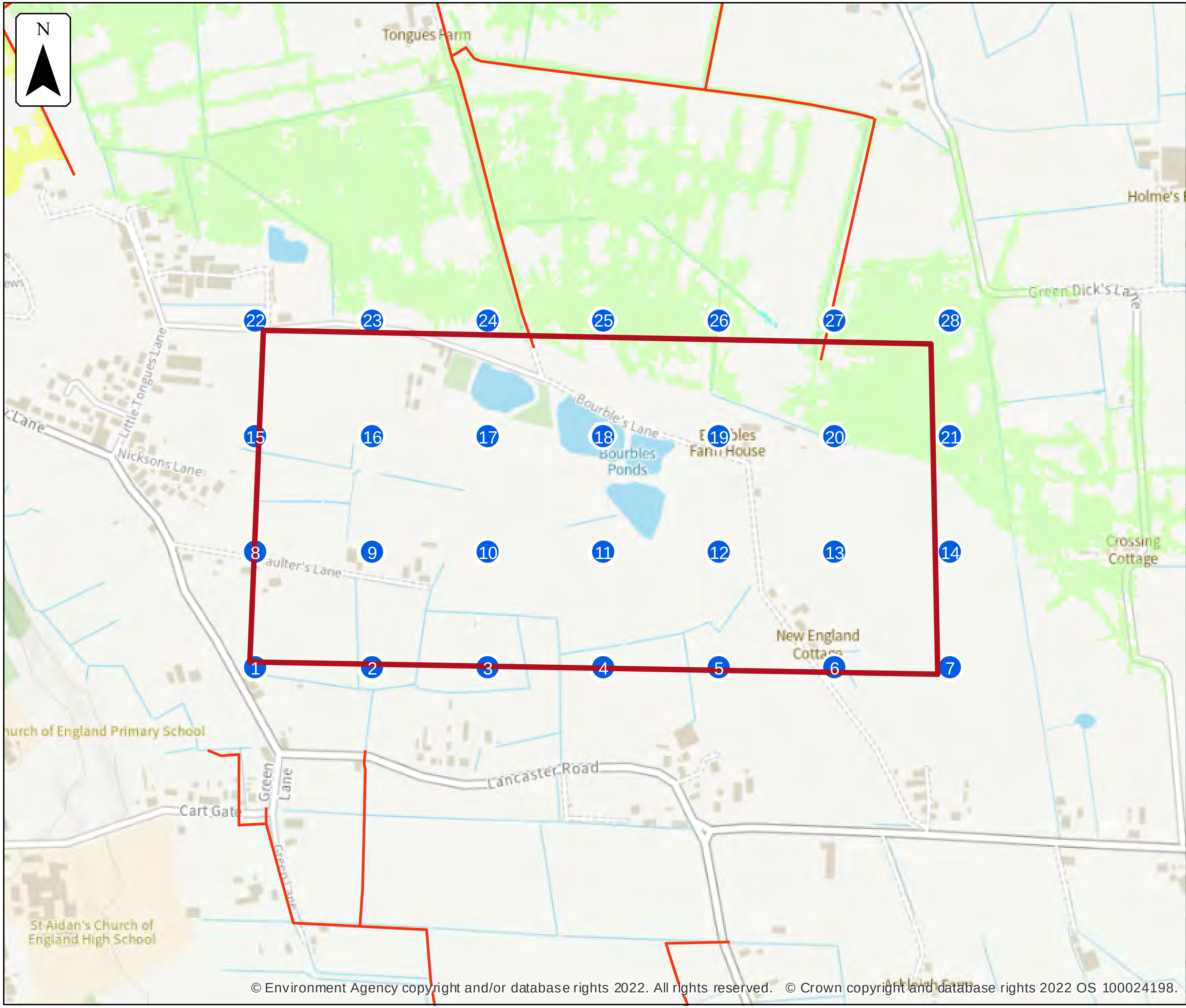
0 50 100 150 200 250
metres

Modelled node locations data

Defended climate change

Label	Modelled location ID	Easting	Northing	1.0% AEP (+30%)		1.0% AEP (+35%)		1.0% AEP (+70%)	
				Level	Flow	Level	Flow	Level	Flow
1	978569	337486	448054	4.92	0.27	4.93	0.28	4.98	0.29
2	978614	337496	448018	4.97	0.12	4.98	0.13	4.98	0.12
3	978565	337511	447968	4.93	0.13	4.94	0.13	4.98	0.21
4	978642	337537	447885	4.93	0.10	4.94	0.10	4.98	0.10
5	978631	337953	447855	4.97	0.10	4.97	0.10	4.99	0.10
6	978632	337960	447891	4.97	0.10	4.97	0.10	4.99	0.10
7	978619	337970	447938	4.92	0.11	4.92	0.11	4.98	0.23
8	978577	337991	448022	4.92	0.16	4.93	0.16	4.98	0.24
9	978561	338013	448110	4.92	0.16	4.93	0.16	4.98	0.24

Data in this table comes from the Preesall 2018 model.
Level values are shown in mAOD, and flow values are shown in cubic metres per second.
Any blank cells show where a particular scenario has not been modelled for this location.



Environment Agency

Defended climate change modelled fluvial extent and height

Location (easting/northing)
337634/447640

Scale **1:7,500**

Created **13 Dec 2022**

Model name
Preesall 2018

Selected area

Main river

Modelled 2D grid

Water level in mAOD

- 0 - 4.0
- 4.0 - 4.25
- 4.25 - 4.5
- 4.5 - 4.75
- 4.75 - 5.0
- 5.0 - 5.25
- 5.25 - 5.5
- 5.5 - 5.75
- 5.75 - 6.0

This map shows the 1.0% AEP +70% height data

0 100 200 300
metres

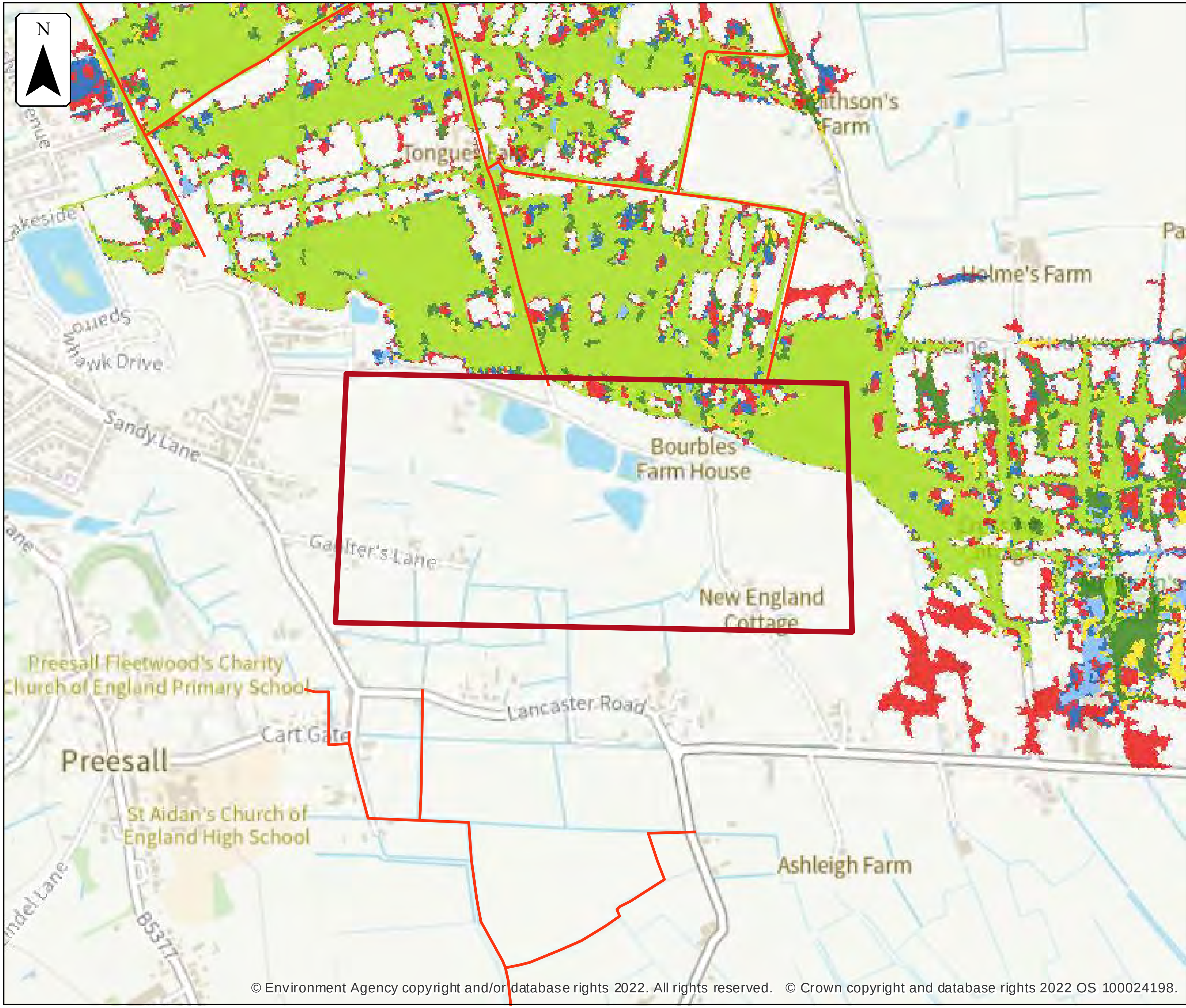
Sample point data

Defended climate change

Label	Easting	Northing	1% AEP (+30%)		1% AEP (+35%)		1% AEP (+70%)	
			Depth	Height	Depth	Height	Depth	Height
1	337139	447400	NoData	NoData	NoData	NoData	NoData	NoData
2	337308	447400	NoData	NoData	NoData	NoData	NoData	NoData
3	337477	447400	NoData	NoData	NoData	NoData	NoData	NoData
4	337646	447400	NoData	NoData	NoData	NoData	NoData	NoData
5	337815	447400	NoData	NoData	NoData	NoData	NoData	NoData
6	337984	447400	NoData	NoData	NoData	NoData	NoData	NoData
7	338153	447400	NoData	NoData	NoData	NoData	NoData	NoData
8	337139	447569	NoData	NoData	NoData	NoData	NoData	NoData
9	337308	447569	NoData	NoData	NoData	NoData	NoData	NoData
10	337477	447569	NoData	NoData	NoData	NoData	NoData	NoData
11	337646	447569	NoData	NoData	NoData	NoData	NoData	NoData
12	337815	447569	NoData	NoData	NoData	NoData	NoData	NoData
13	337984	447569	NoData	NoData	NoData	NoData	NoData	NoData
14	338153	447569	NoData	NoData	NoData	NoData	NoData	NoData
15	337139	447738	NoData	NoData	NoData	NoData	NoData	NoData
16	337308	447738	NoData	NoData	NoData	NoData	NoData	NoData

Label	Easting	Northing	1% AEP (+30%)		1% AEP (+35%)		1% AEP (+70%)	
			Depth	Height	Depth	Height	Depth	Height
17	337477	447738	NoData	NoData	NoData	NoData	NoData	NoData
18	337646	447738	NoData	NoData	NoData	NoData	NoData	NoData
19	337815	447738	NoData	NoData	NoData	NoData	NoData	NoData
20	337984	447738	NoData	NoData	NoData	NoData	0.06	4.98
21	338153	447738	0.06	4.87	0.09	4.89	0.17	4.98
22	337139	447907	NoData	NoData	NoData	NoData	NoData	NoData
23	337308	447907	NoData	NoData	NoData	NoData	NoData	NoData
24	337477	447907	NoData	NoData	NoData	NoData	0.07	4.98
25	337646	447907	NoData	NoData	0.04	4.89	0.13	4.98
26	337815	447907	NoData	NoData	NoData	NoData	0.30	4.98
27	337984	447907	0.12	4.88	0.14	4.90	0.22	4.98
28	338153	447907	0.01	4.88	0.03	4.89	0.11	4.98

Data in this table comes from the Preesall 2018 model.
Height values are shown in mAOD, and depth values are shown in metres.
Any blank cells show where a particular scenario has not been modelled for this location.
Cells which contain text 'NoData' for a scenario show that return period has been modelled but there is no flood risk for that return period for that location.



Environment Agency

Defences removed modelled fluvial extent

Location (easting/northing)
337634/447640

Scale **1:10,000**

Created **13 Dec 2022**

Model name
Preesall 2018

Selected area

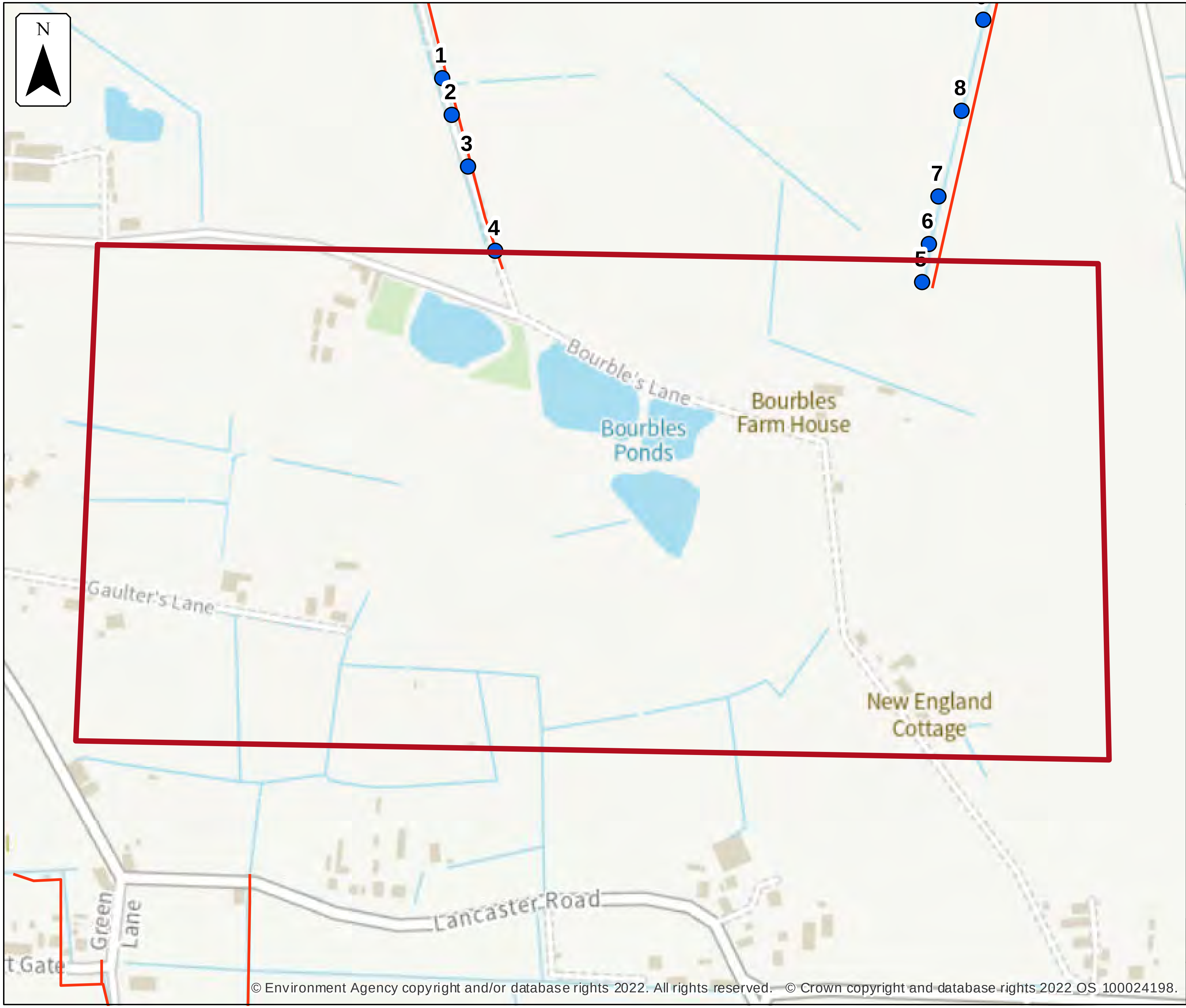
Main river

Modelled flood extent

- 5% AEP
- 2% AEP
- 1.33% AEP
- 1% AEP
- 0.5% AEP
- 0.1% AEP

Flood extents may not be visible where they overlap other return periods

0 100 200 300 400 500
metres



Environment Agency

Defences removed modelled fluvial node locations

Location (easting/northing)
337634/447640

Scale
1:5,000

Created
13 Dec 2022

Model name
Preesall 2018

Selected area
Modelled location
Main river

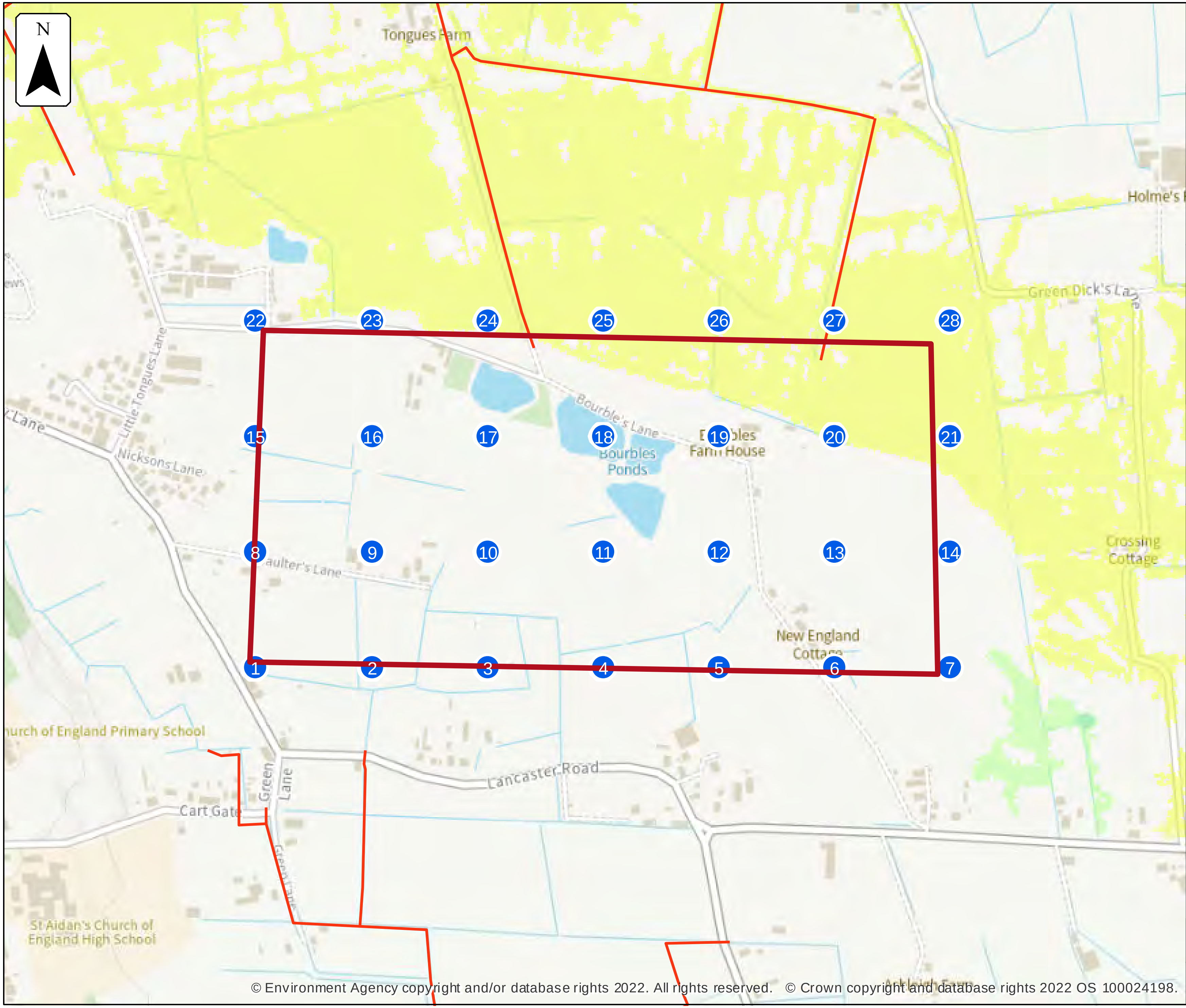
0 50 100 150 200 250
metres

Modelled node locations data

Defences removed

Label	Modelled location ID	Easting	Northing	5% AEP		2% AEP		1.33% AEP		1% AEP		0.5% AEP		0.1% AEP	
				Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow
1	978569	337486	448054	4.99	0.23	5.0	0.25	5.01	0.22	5.01	0.23	5.03	0.23	5.05	0.21
2	978614	337496	448018	4.99	0.10	5.0	0.10	5.01	0.10	5.01	0.10	5.03	0.10	5.05	0.10
3	978565	337511	447968	4.99	0.10	5.0	0.10	5.01	0.10	5.01	0.10	5.03	0.10	5.05	0.10
4	978642	337537	447885	4.99	0.10	5.0	0.10	5.01	0.10	5.01	0.10	5.03	0.10	5.05	0.10
5	978631	337953	447855	5.0	0.10	5.01	0.10	5.01	0.10	5.01	0.10	5.02	0.10	5.05	0.10
6	978632	337960	447891	5.0	0.10	5.01	0.10	5.01	0.10	5.01	0.10	5.02	0.10	5.05	0.10
7	978619	337970	447938	4.99	0.10	5.0	0.10	5.01	0.10	5.01	0.10	5.02	0.10	5.05	0.10
8	978577	337991	448022	4.99	0.12	5.0	0.12	5.01	0.12	5.01	0.12	5.02	0.12	5.05	0.13
9	978561	338013	448110	4.99	0.12	5.0	0.12	5.01	0.12	5.01	0.12	5.02	0.12	5.05	0.12

Data in this table comes from the Preesall 2018 model.
Level values are shown in mAOD, and flow values are shown in cubic metres per second.
Any blank cells show where a particular scenario has not been modelled for this location.



Environment Agency

Defences removed modelled fluvial extent and height

Location (easting/northing)
337634/447640

Scale
1:7,500

Created
13 Dec 2022

Model name
Preesall 2018

Selected area

Main river

Modelled 2D grid

Water level in mAOD

0 - 4.0
4.0 - 4.25
4.25 - 4.5
4.5 - 4.75
4.75 - 5.0
5.0 - 5.25
5.25 - 5.5
5.5 - 5.75
5.75 - 6.0

This map shows the 0.1% AEP height data

0 100 200 300
metres

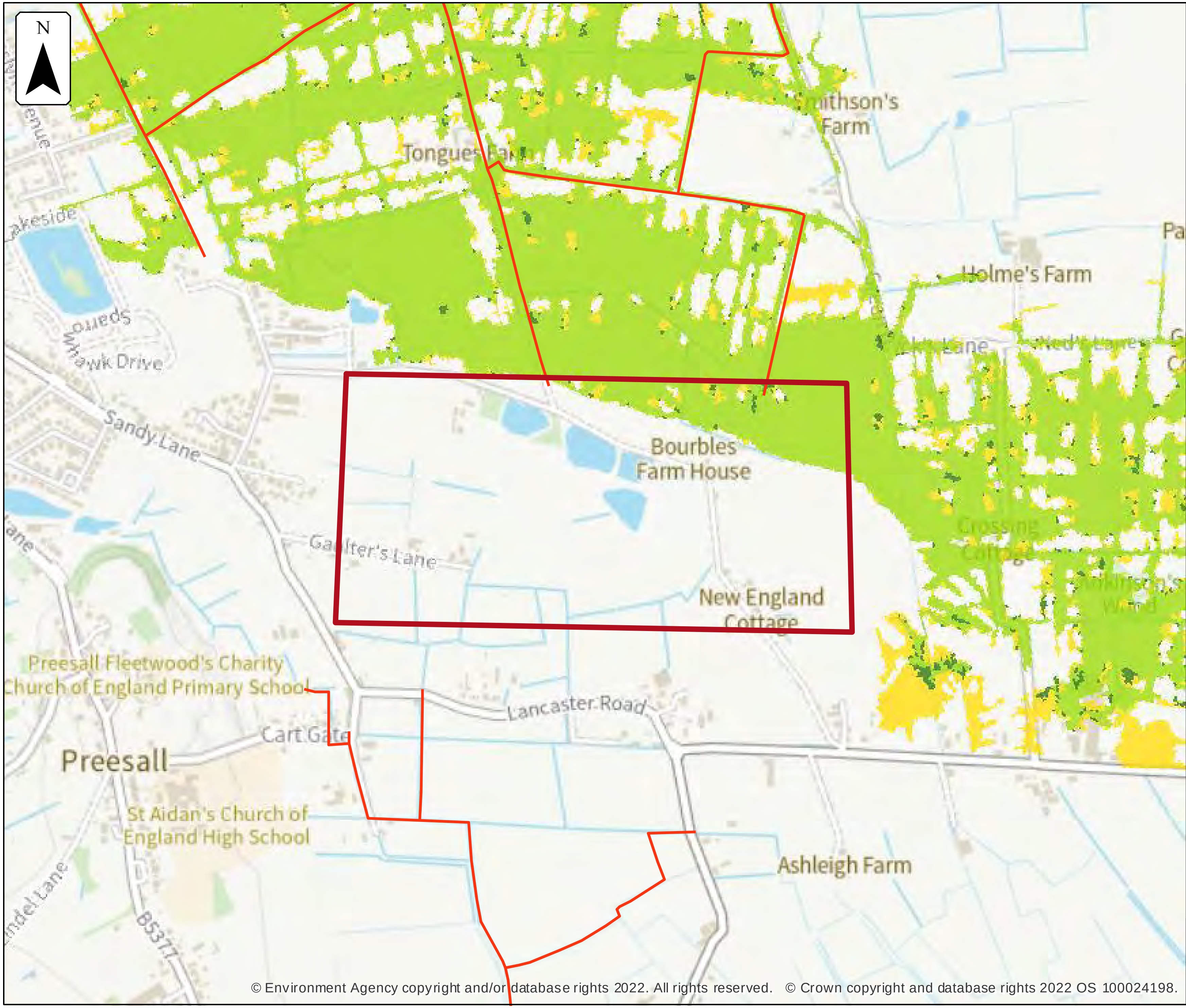
Sample point data

Defences removed

Label	Easting	Northing	5% AEP		2% AEP		1.33% AEP		1% AEP		0.5% AEP		0.1% AEP	
			Depth	Height	Depth	Height	Depth	Height	Depth	Height	Depth	Height	Depth	Height
1	337139	447400	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
2	337308	447400	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
3	337477	447400	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
4	337646	447400	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
5	337815	447400	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
6	337984	447400	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
7	338153	447400	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
8	337139	447569	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
9	337308	447569	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
10	337477	447569	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
11	337646	447569	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
12	337815	447569	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
13	337984	447569	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
14	338153	447569	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
15	337139	447738	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
16	337308	447738	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData

Label	Easting	Northing	5% AEP		2% AEP		1.33% AEP		1% AEP		0.5% AEP		0.1% AEP	
			Depth	Height	Depth	Height	Depth	Height	Depth	Height	Depth	Height	Depth	Height
17	337477	447738	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
18	337646	447738	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
19	337815	447738	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
20	337984	447738	0.07	4.99	0.08	5.00	0.09	5.01	0.09	5.01	0.10	5.02	0.13	5.05
21	338153	447738	0.18	4.99	0.20	5.00	0.20	5.01	0.21	5.01	0.22	5.02	0.24	5.05
22	337139	447907	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
23	337308	447907	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData
24	337477	447907	0.07	4.99	0.09	5.00	0.09	5.01	0.10	5.01	0.11	5.02	0.13	5.05
25	337646	447907	0.14	4.99	0.15	5.00	0.16	5.01	0.16	5.01	0.17	5.02	0.20	5.05
26	337815	447907	0.31	4.99	0.33	5.00	0.33	5.01	0.33	5.01	0.34	5.02	0.37	5.05
27	337984	447907	0.23	4.99	0.24	5.00	0.25	5.01	0.25	5.01	0.26	5.02	0.29	5.05
28	338153	447907	0.12	4.99	0.13	5.00	0.14	5.01	0.14	5.01	0.15	5.02	0.18	5.05

Data in this table comes from the Preesall 2018 model.
Height values are shown in mAOD, and depth values are shown in metres.
Any blank cells show where a particular scenario has not been modelled for this location.
Cells which contain text 'NoData' for a scenario show that return period has been modelled but there is no flood risk for that return period for that location.



Environment Agency

Defences removed climate change modelled fluvial extent

Location (easting/northing)
337634/447640

Scale **1:10,000**

Created **13 Dec 2022**

Model name
Preesall 2018

Selected area

Main river

Modelled flood extent

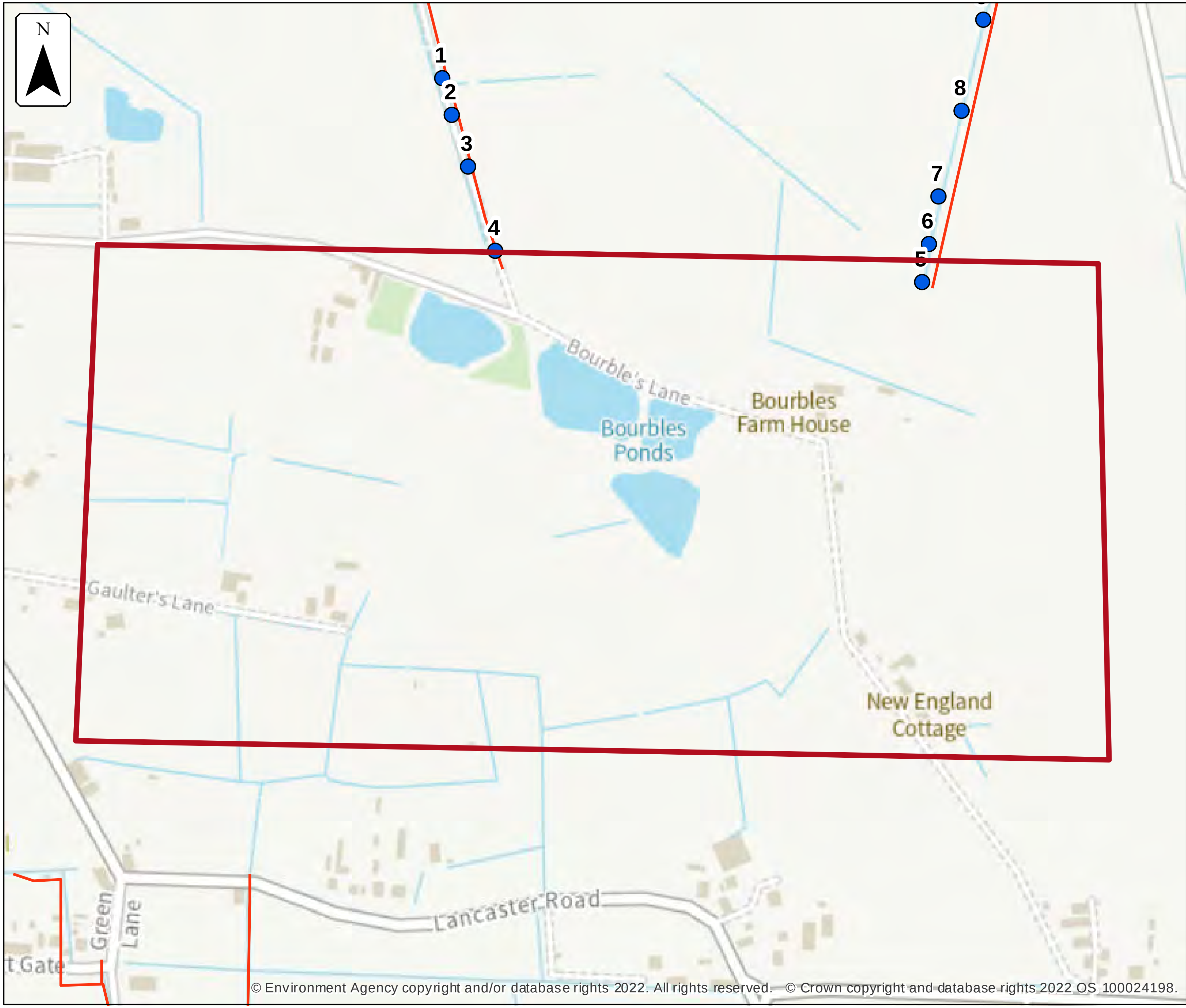
1.0% AEP (+30%)

1.0% AEP (+35%)

1.0% AEP (+70%)

Flood extents may not be visible where they overlap other return periods

0 100 200 300 400 500
metres



Environment Agency

Defences removed climate change modelled fluvial node locations

Location (easting/northing)
337634/447640

Scale
1:5,000

Created
13 Dec 2022

Model name
Preesall 2018

Selected area
Modelled location
Main river

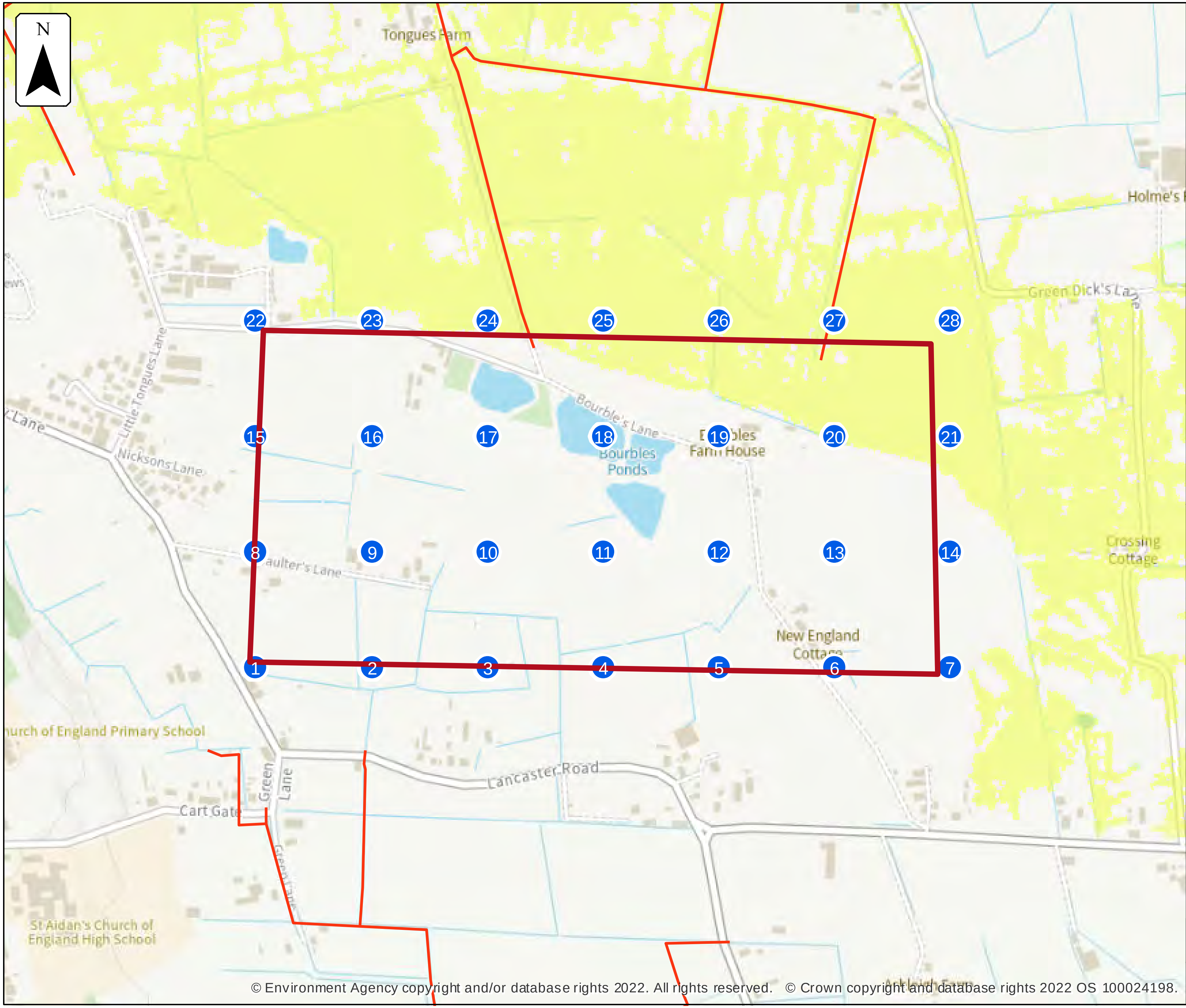
0 50 100 150 200 250
metres

Modelled node locations data

Defences removed climate change

Label	Modelled location ID	Easting	Northing	1.0% AEP (+30%)		1.0% AEP (+35%)		1.0% AEP (+70%)	
				Level	Flow	Level	Flow	Level	Flow
1	978569	337486	448054	5.04	0.23	5.04	0.22	5.06	0.22
2	978614	337496	448018	5.04	0.10	5.04	0.10	5.06	0.10
3	978565	337511	447968	5.04	0.10	5.04	0.10	5.06	0.10
4	978642	337537	447885	5.04	0.10	5.04	0.10	5.06	0.10
5	978631	337953	447855	5.04	0.10	5.04	0.10	5.06	0.10
6	978632	337960	447891	5.04	0.10	5.04	0.10	5.06	0.10
7	978619	337970	447938	5.03	0.10	5.04	0.10	5.06	0.10
8	978577	337991	448022	5.03	0.12	5.04	0.13	5.06	0.13
9	978561	338013	448110	5.03	0.12	5.04	0.12	5.06	0.12

Data in this table comes from the Preesall 2018 model.
Level values are shown in mAOD, and flow values are shown in cubic metres per second.
Any blank cells show where a particular scenario has not been modelled for this location.



Environment Agency

Defences removed climate change modelled fluvial extent and height

Location (easting/northing)
337634/447640

Scale **1:7,500**

Created **13 Dec 2022**

Model name
Preesall 2018

Selected area

Main river

Modelled 2D grid

Water level in mAOD

- 0 - 4.0
- 4.0 - 4.25
- 4.25 - 4.5
- 4.5 - 4.75
- 4.75 - 5.0
- 5.0 - 5.25
- 5.25 - 5.5
- 5.5 - 5.75
- 5.75 - 6.0

This map shows the 1.0% AEP +70% height data

0 100 200 300
metres

Sample point data

Defences removed climate change

Label	Easting	Northing	1% AEP (+30%)		1% AEP (+35%)		1% AEP (+70%)	
			Depth	Height	Depth	Height	Depth	Height
1	337139	447400	NoData	NoData	NoData	NoData	NoData	NoData
2	337308	447400	NoData	NoData	NoData	NoData	NoData	NoData
3	337477	447400	NoData	NoData	NoData	NoData	NoData	NoData
4	337646	447400	NoData	NoData	NoData	NoData	NoData	NoData
5	337815	447400	NoData	NoData	NoData	NoData	NoData	NoData
6	337984	447400	NoData	NoData	NoData	NoData	NoData	NoData
7	338153	447400	NoData	NoData	NoData	NoData	NoData	NoData
8	337139	447569	NoData	NoData	NoData	NoData	NoData	NoData
9	337308	447569	NoData	NoData	NoData	NoData	NoData	NoData
10	337477	447569	NoData	NoData	NoData	NoData	NoData	NoData
11	337646	447569	NoData	NoData	NoData	NoData	NoData	NoData
12	337815	447569	NoData	NoData	NoData	NoData	NoData	NoData
13	337984	447569	NoData	NoData	NoData	NoData	NoData	NoData
14	338153	447569	NoData	NoData	NoData	NoData	NoData	NoData
15	337139	447738	NoData	NoData	NoData	NoData	NoData	NoData
16	337308	447738	NoData	NoData	NoData	NoData	NoData	NoData

Label	Easting	Northing	1% AEP (+30%)		1% AEP (+35%)		1% AEP (+70%)	
			Depth	Height	Depth	Height	Depth	Height
17	337477	447738	NoData	NoData	NoData	NoData	NoData	NoData
18	337646	447738	NoData	NoData	NoData	NoData	NoData	NoData
19	337815	447738	NoData	NoData	NoData	NoData	NoData	NoData
20	337984	447738	0.11	5.03	0.12	5.04	0.14	5.06
21	338153	447738	0.23	5.03	0.23	5.04	0.25	5.06
22	337139	447907	NoData	NoData	NoData	NoData	NoData	NoData
23	337308	447907	NoData	NoData	NoData	NoData	NoData	NoData
24	337477	447907	0.12	5.04	0.12	5.04	0.14	5.06
25	337646	447907	0.18	5.04	0.19	5.04	0.21	5.06
26	337815	447907	0.36	5.04	0.36	5.04	0.38	5.06
27	337984	447907	0.27	5.03	0.28	5.04	0.30	5.06
28	338153	447907	0.17	5.03	0.17	5.04	0.19	5.06

Data in this table comes from the Preesall 2018 model.
Height values are shown in mAOD, and depth values are shown in metres.
Any blank cells show where a particular scenario has not been modelled for this location.
Cells which contain text 'NoData' for a scenario show that return period has been modelled but there is no flood risk for that return period for that location.

Strategic flood risk assessments

We recommend that you check the relevant local authority's strategic flood risk assessment (SFRA) as part of your work to prepare a site specific flood risk assessment.

This should give you information about:

- the potential impacts of climate change in this catchment
- areas defined as functional floodplain
- flooding from other sources, such as surface water, ground water and reservoirs

About this data

This data has been generated by strategic scale flood models and is not intended for use at the individual property scale. If you're intending to use this data as part of a flood risk assessment, please include an appropriate modelling tolerance as part of your assessment. The Environment Agency regularly updates its modelling. We recommend that you check the data provided is the most recent, before submitting your flood risk assessment.

Flood risk activity permits

Under the Environmental Permitting (England and Wales) Regulations 2016 some developments may require an environmental permit for flood risk activities from the Environment Agency. This includes any permanent or temporary works that are in, over, under, or nearby a designated main river or flood defence structure.

Find out more about flood risk activity permits

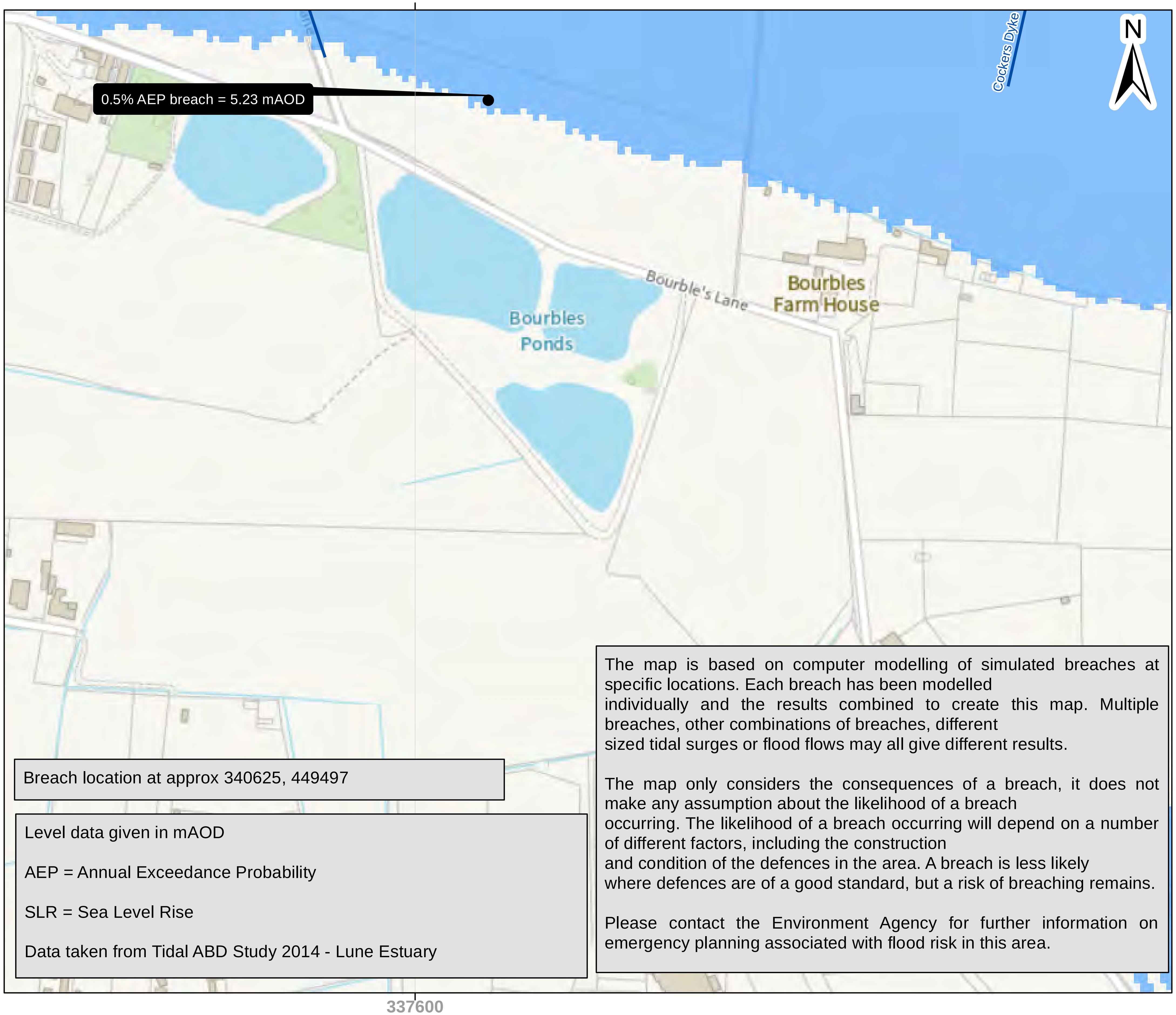
Help and advice

Contact the Cumbria and Lancashire Environment Agency team at inforequests.cmblnc@environment-agency.gov.uk for:

- more information about getting a product 5, 6, 7 or 8
- general help and advice about the site you're requesting data for

APPENDIX 3133/FRA/A5

Environment Agency Product 8



Breach location at approx 340625, 449497

Level data given in mAOD

AEP = Annual Exceedance Probability

SLR = Sea Level Rise

Data taken from Tidal ABD Study 2014 - Lune Estuary

The map is based on computer modelling of simulated breaches at specific locations. Each breach has been modelled individually and the results combined to create this map. Multiple breaches, other combinations of breaches, different sized tidal surges or flood flows may all give different results.

The map only considers the consequences of a breach, it does not make any assumption about the likelihood of a breach occurring. The likelihood of a breach occurring will depend on a number of different factors, including the construction and condition of the defences in the area. A breach is less likely where defences are of a good standard, but a risk of breaching remains.

Please contact the Environment Agency for further information on emergency planning associated with flood risk in this area.

Environment Agency

Modelled 2D Data Map

Bourbles Farm, FY6 0PE

Produced: 14/12/2022
Our Ref: CL286350
NGR: SD3778247617

Key

Main River

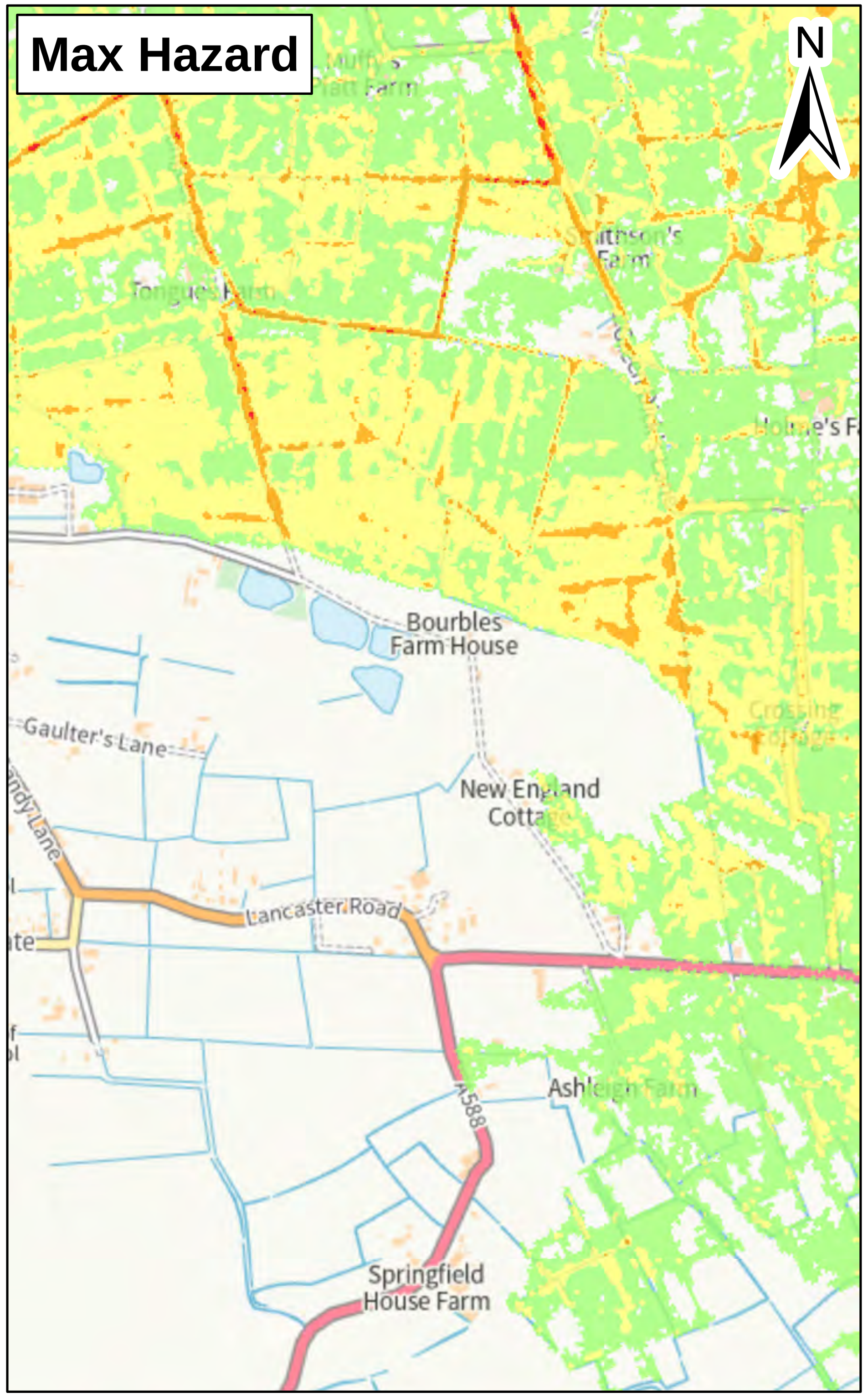
0.5% AEP tidal breach

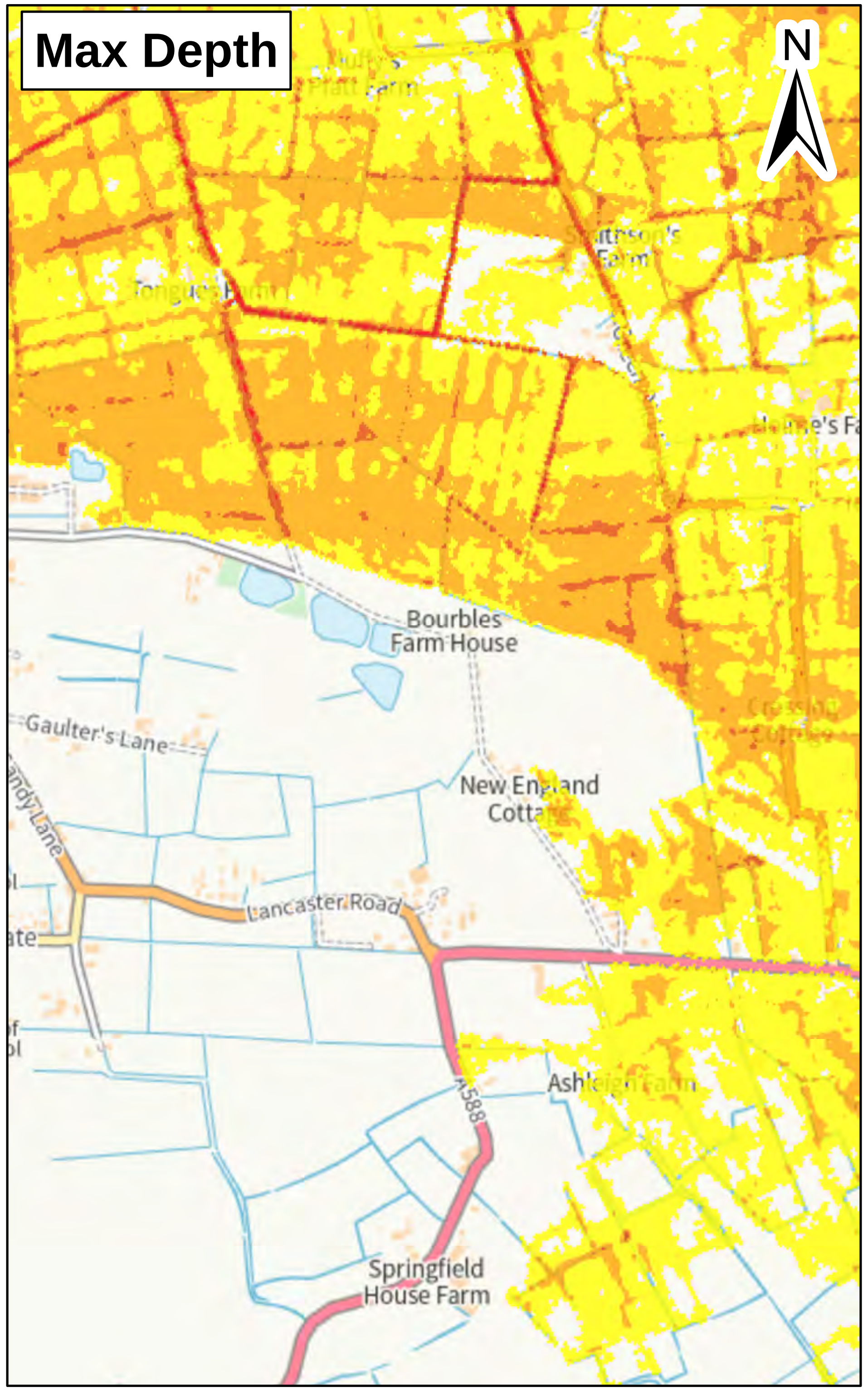
Value

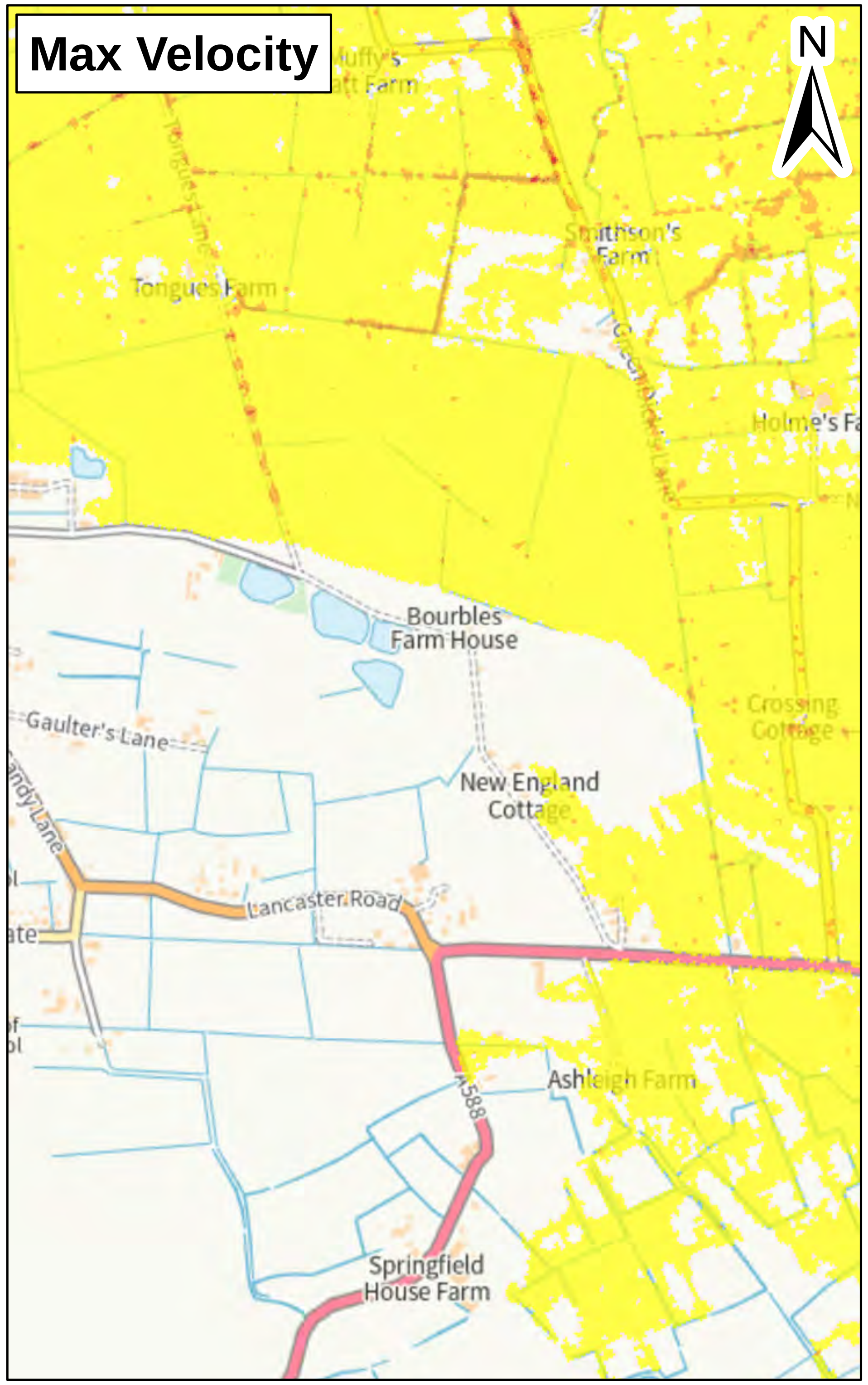
High : 11.8116

Low : 3.6007

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk







Modelled Breach Location

Max Hazard
(Flood Risk to People : FD2320)

- Less than 0.75 (Low Hazard)
- Between 0.75 and 1.25 (Danger for Some)
- Between 1.25 and 2.0 (Danger for Most)
- Greater than 2.0 (Danger for All)

Max Depth (m)

- 0 - 0.25
- 0.25 - 0.50
- 0.50 - 1.0
- 1.0 - 2.0
- 2.0 +

Max Velocity (m/s)

- 0 - 0.3
- 0.3 - 1.0
- 1.0 - 1.5
- 1.5 - 2.5
- 2.5 +

Date Printed	14/12/2022	Scenario year	2014	Scenario Annual Chance	0.5% (1 in 200)

This map shows the level of flood hazard to people (called a hazard rating) if our flood defences are breached at certain locations, for a range of scenarios. The hazard rating depends on the depth and velocity of floodwater, and maximum values of these are also mapped.

The map is based on computer modelling of simulated breaches at specific locations. Each breach has been modelled individually and the results combined to create this map. Multiple breaches, other combinations of breaches, different sized tidal surges or flood flows may all give different results.

The map only considers the consequences of a breach, it does not make any assumption about the likelihood of a breach occurring. The likelihood of a breach occurring will depend on a number of different factors, including the construction and condition of the defences in the area. A breach is less likely where defences are of a good standard, but a risk of breaching remains.

Please contact the Environment Agency for further information on emergency planning associated with flood risk in this area

Environment Agency

Tidal Hazard Mapping: Bourbles Farm, Preesall
Our Ref: CL286350
Date 14/12/2022
NGR: SD3778247617

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

APPENDIX 3133/FRA/A6

Environment Agency flood defence data

CL232740 Bourbles Farm, Preesall

September 9, 2021

- Beach
- Bridge Abutment
- Cliff
- Demountable Defence
- Dunes
- Embankment
- Engineered High Ground
- Flood Gate
- Natural High Ground
- Spillway
- Wall
- Open Channel
- Simple Culvert
- Complex Culvert
- Outfall

Site Location	Bourbles Farm, Preesall	CL232740

Coastal Defences

Asset ID	National Grid Reference	Asset Type	Protection Type	Location	Maintained By	Design Standard (Return Period)	Overall Condition Grade	Effective Crest Level (m) UCL (mAOD)	Effective Crest Level (m) DCL (mAOD)	E.C.L Data Quality (Reliable 1-4 Unreliable)	Length (m)	Height (m)
100903	SD3543948644	Embankment	Coastal	1st Groyne to Rear of Caravan Park	Environment Agency	200	3 - Fair	7.61		2	904.86	-
138594	SD3624848975	Embankment	Coastal	Rear of Caravan Park to Fluke Hall Lane (ramp)	Environment Agency	200	3 - Fair	7.82		2	2984.24	-
53770	SD3895450052	Embankment	Coastal	Fluke Hall Lane (ramp) to Sluice	Environment Agency	200	3 - Fair	8		2	356.26	-

The Environmental Permitting (England and Wales) Regulations 2016 require a permit to be obtained for any activities which will take place:

- **on or within 8 metres of a flood defence structure or culvert (16 metres if tidal)**
- **on or within 16 metres of a sea defence**

Site Location	Bourbles Farm, Preesall	CL232740

Coastal Structures

Asset ID	National Grid Reference	Asset Type	Protection Type	Location	Maintained By	Design Standard (Return Period)	Overall Condition Grade	Width (m)	Height (m)
305545	SD35814884	Outfall	Coastal	Rear of Properties off Hawkshead Road	Unknown	-	3 - Fair	-	-
305546	SD36184896	Outfall	Coastal	Rear of Caravan Park	Private	-	3 - Fair	-	-
222714	SD37434959	Outfall	Coastal	Off Pilling Lane, Pilling, down track adjacent to no. 285.	Environment Agency	-	3 - Fair	-	-

APPENDIX 3133/FRA/A7

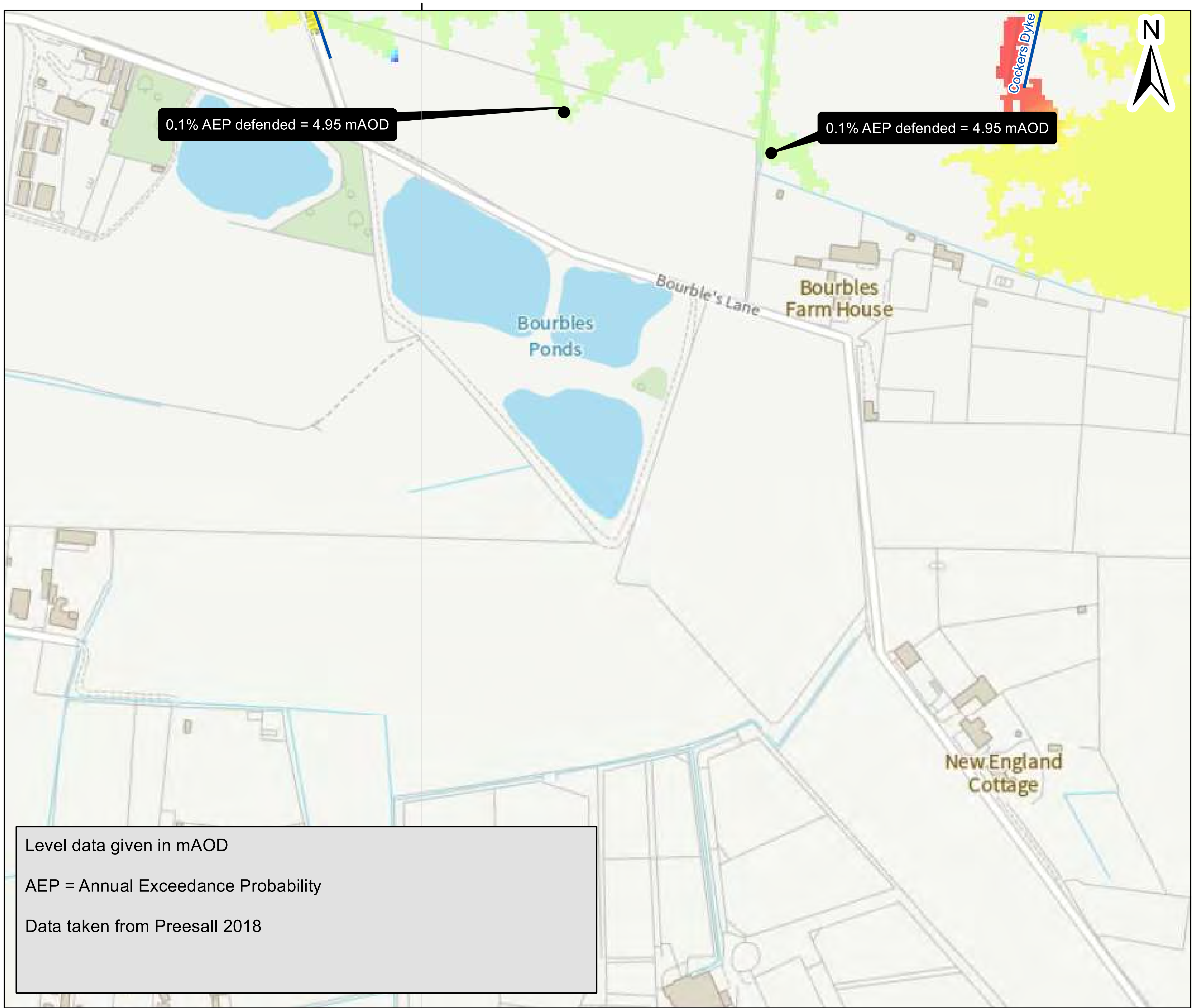
Environment Agency Fluvial Flood Risk Mapping

Environment Agency

Modelled 2D Data Map

Bourbles Farm, FY6 0PE

Produced: 15 Sep 2021
Our Ref: CL232740
NGR: 337706, 447596



Level data given in mAOD

AEP = Annual Exceedance Probability

Data taken from Preesall 2018

Key

Main River

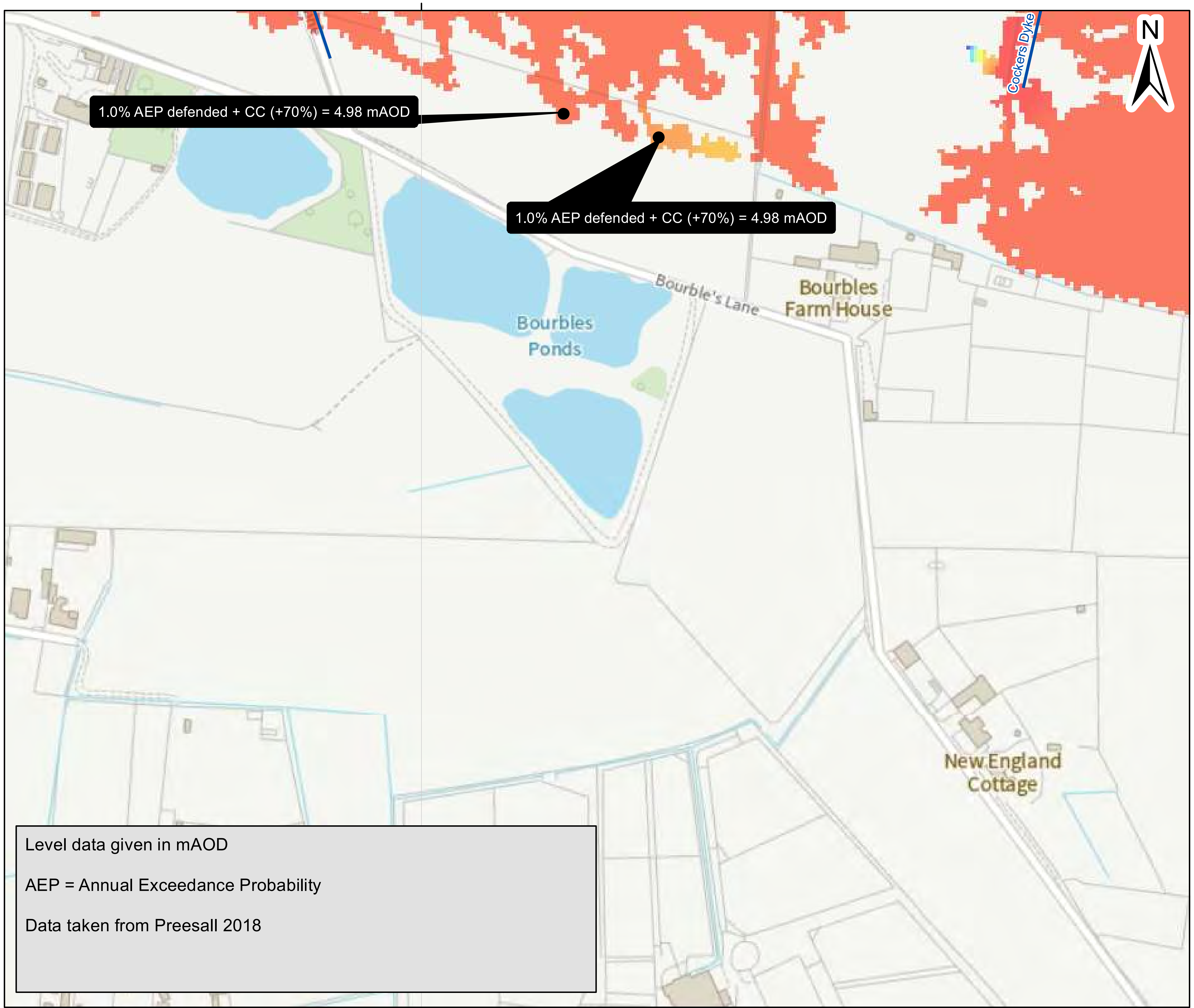
0.1% AEP fluvial defended

Value

- 4.9803
- 4.95934
- 4.93862
- 4.9179

Modelled water levels with climate change using +20% flow allowances are not suitable for the majority of planning purposes. New climate change allowances can be checked on the following website; www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances.

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk



Level data given in mAOD

AEP = Annual Exceedance Probability

Data taken from Preesall 2018

Environment Agency

Modelled 2D Data Map

Bourbles Farm, FY6 0PE

Produced: 15 Sep 2021
Our Ref: CL232740
NGR: 337706, 447596

Key

Main River

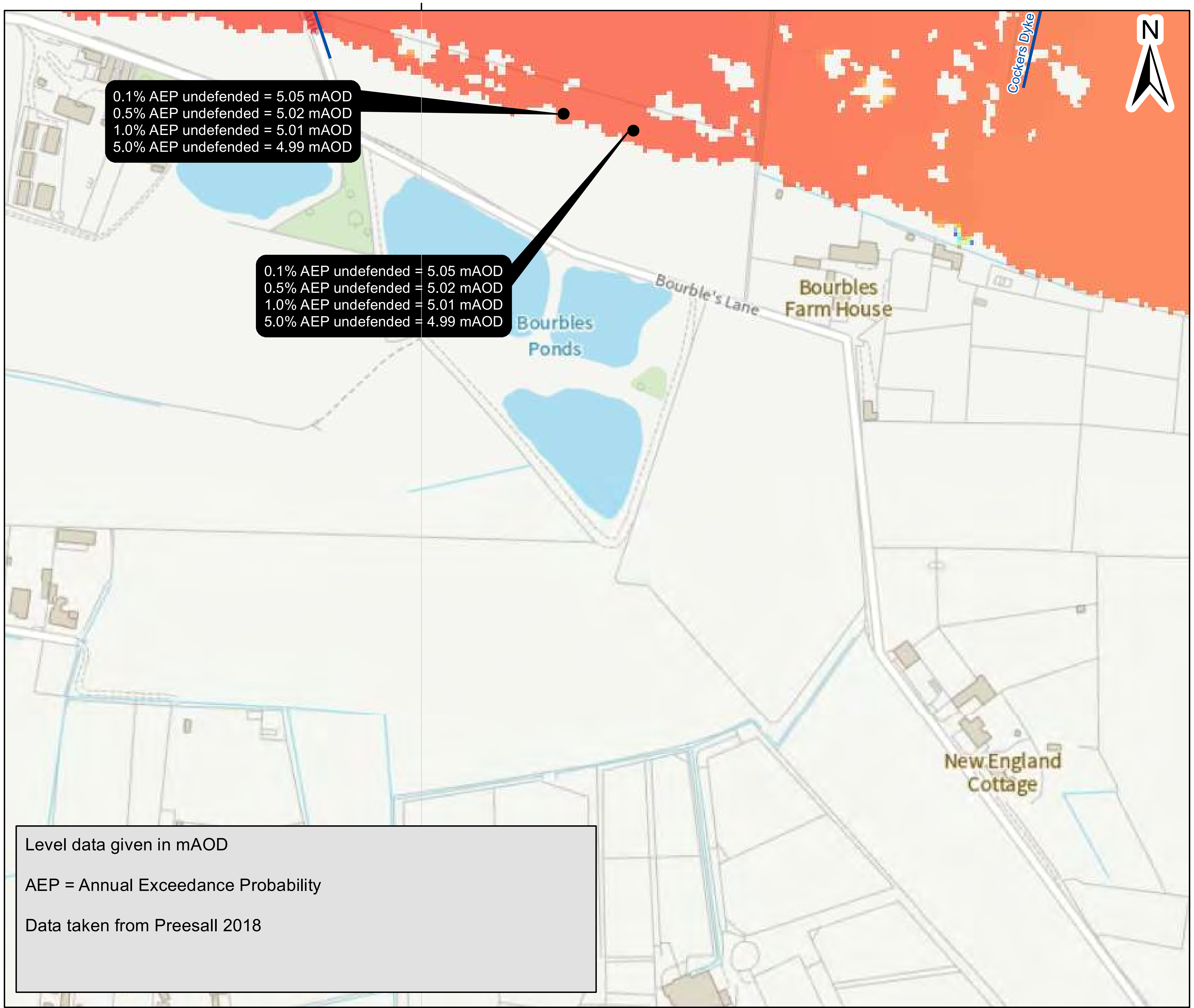
1.0% AEP fluvial defended + 70% Climate Change

Value

4.9909
4.84268
4.69619
4.5497

Modelled water levels with climate change using +20% flow allowances are not suitable for the majority of planning purposes. New climate change allowances can be checked on the following website; www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances.

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk



Level data given in mAOD

AEP = Annual Exceedance Probability

Data taken from Preesall 2018

Modelled 2D Data Map

Bourbles Farm, FY6 0PE

Produced: 15 Sep 2021
Our Ref: CL232740
NGR: 337706, 447596

Key

Main River

0.1% AEP fluvial undefended

Value

5.0531
5.04117
5.02939
5.0176

Modelled water levels with climate change using +20% flow allowances are not suitable for the majority of planning purposes. New climate change allowances can be checked on the following website; www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances.

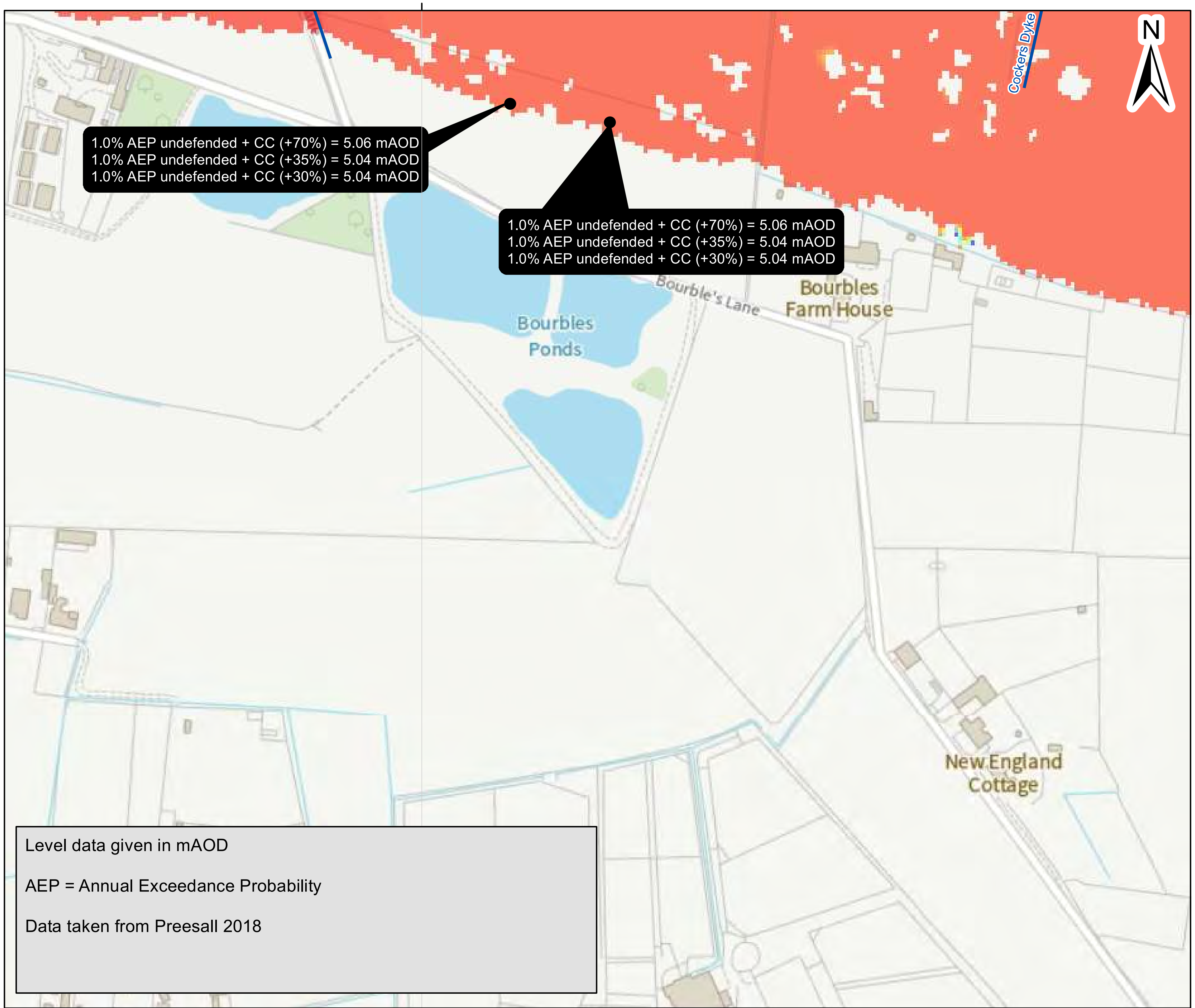
Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Environment Agency

Modelled 2D Data Map

Bourbles Farm, FY6 0PE

Produced: 15 Sep 2021
Our Ref: CL232740
NGR: 337706, 447596



Key

Main River

1.0% AEP fluvial undefended + 70% Climate Change

Value

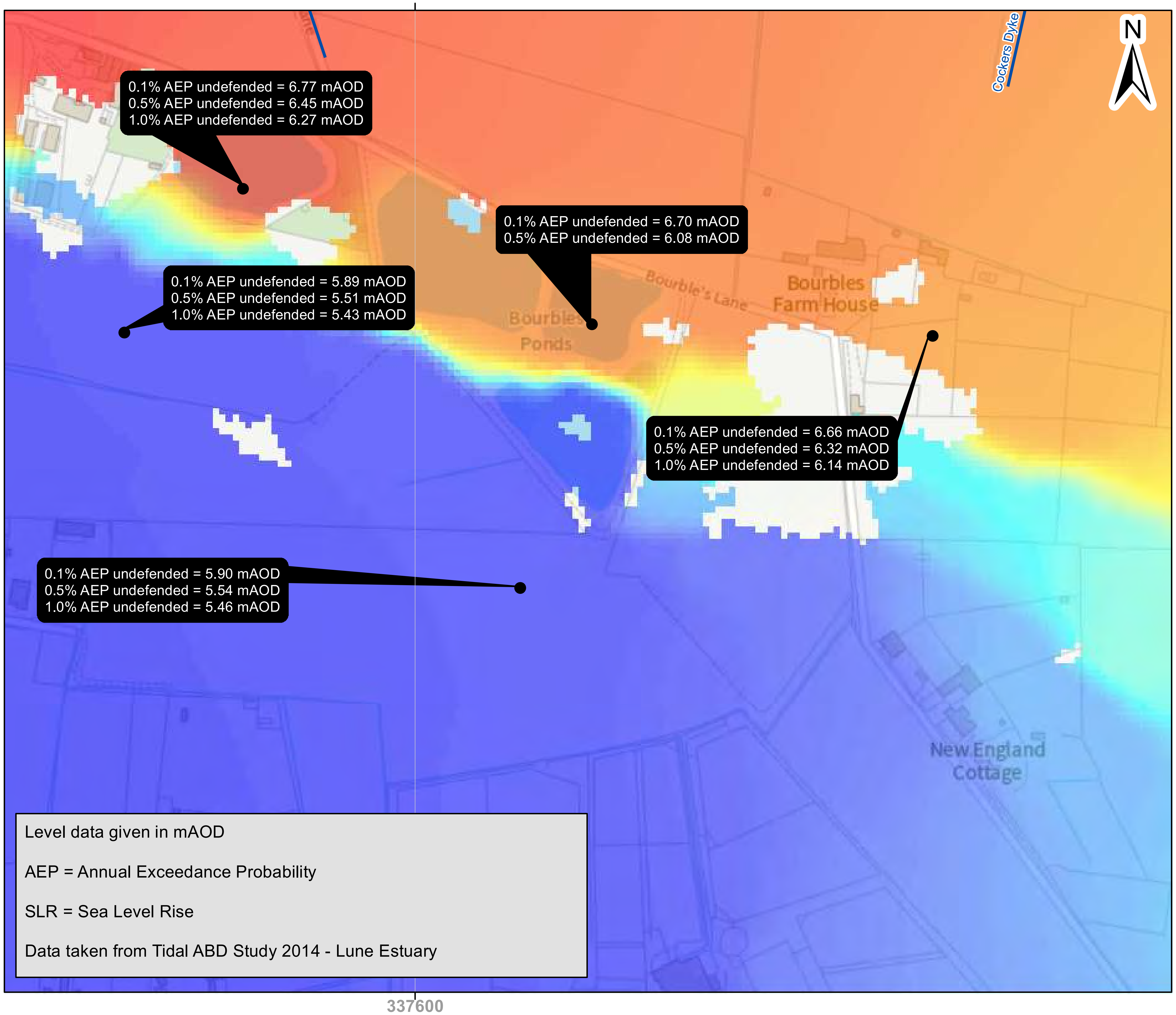
5.0617
5.04937
5.03719
5.025

Modelled water levels with climate change using +20% flow allowances are not suitable for the majority of planning purposes. New climate change allowances can be checked on the following website; www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances.

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

APPENDIX 3133/FRA/A8

Environment Agency Tidal Flood Risk Mapping



Environment Agency

Modelled 2D Data Map

Bourbles Farm, FY6 0PE

Produced: 16 Sep 2021
Our Ref: CL232740
NGR: 337706, 447596

Key

Main River

0.1% AEP tidal undefended

Value

6.791
6.48758
6.18769
5.8878

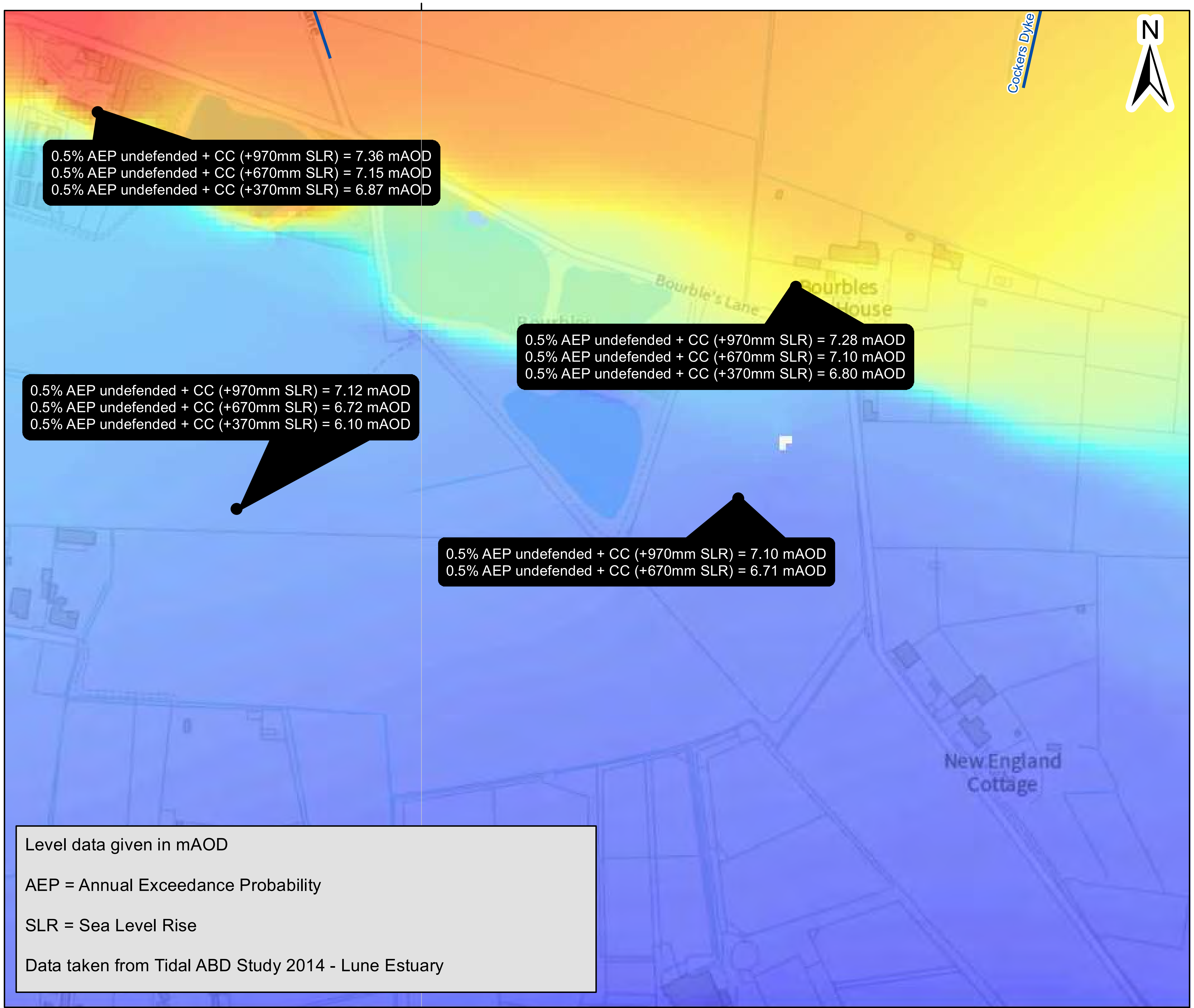
Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Environment Agency

Modelled 2D Data Map

Bourbles Farm, FY6 0PE

Produced: 16 Sep 2021
Our Ref: CL232740
NGR: 337706, 447596



Key

Main River

0.5% AEP tidal undefended + Climate Change (+970mm SLR)

Value

7.387
7.27849
7.17125
7.064

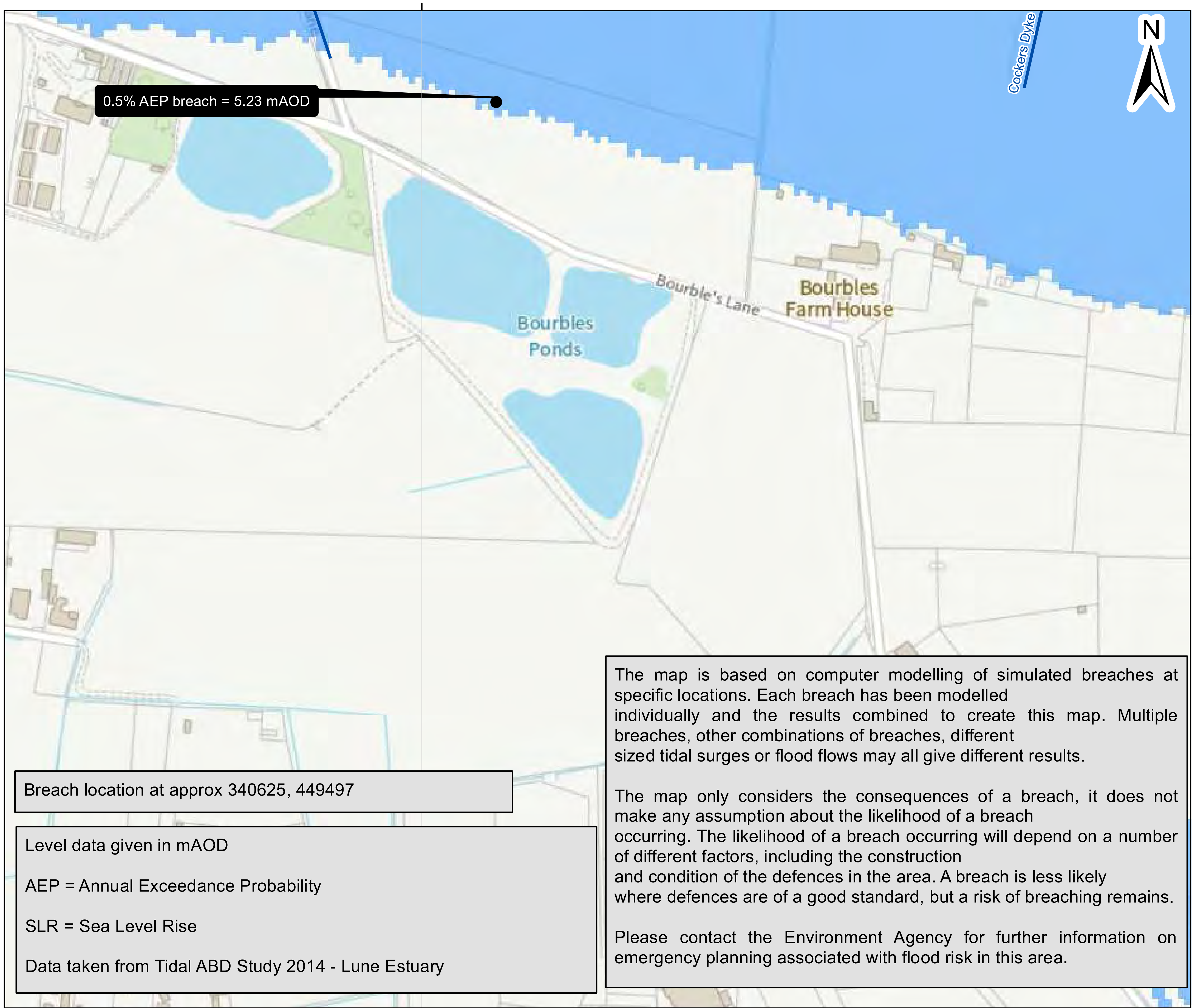
Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Environment Agency

Modelled 2D Data Map

Bourbles Farm, FY6 0PE

Produced: 16 Sep 2021
Our Ref: CL232740
NGR: 337706, 447596



Breach location at approx 340625, 449497

Level data given in mAOD

AEP = Annual Exceedance Probability

SLR = Sea Level Rise

Data taken from Tidal ABD Study 2014 - Lune Estuary

The map is based on computer modelling of simulated breaches at specific locations. Each breach has been modelled individually and the results combined to create this map. Multiple breaches, other combinations of breaches, different sized tidal surges or flood flows may all give different results.

The map only considers the consequences of a breach, it does not make any assumption about the likelihood of a breach occurring. The likelihood of a breach occurring will depend on a number of different factors, including the construction and condition of the defences in the area. A breach is less likely where defences are of a good standard, but a risk of breaching remains.

Please contact the Environment Agency for further information on emergency planning associated with flood risk in this area.

Key

Main River

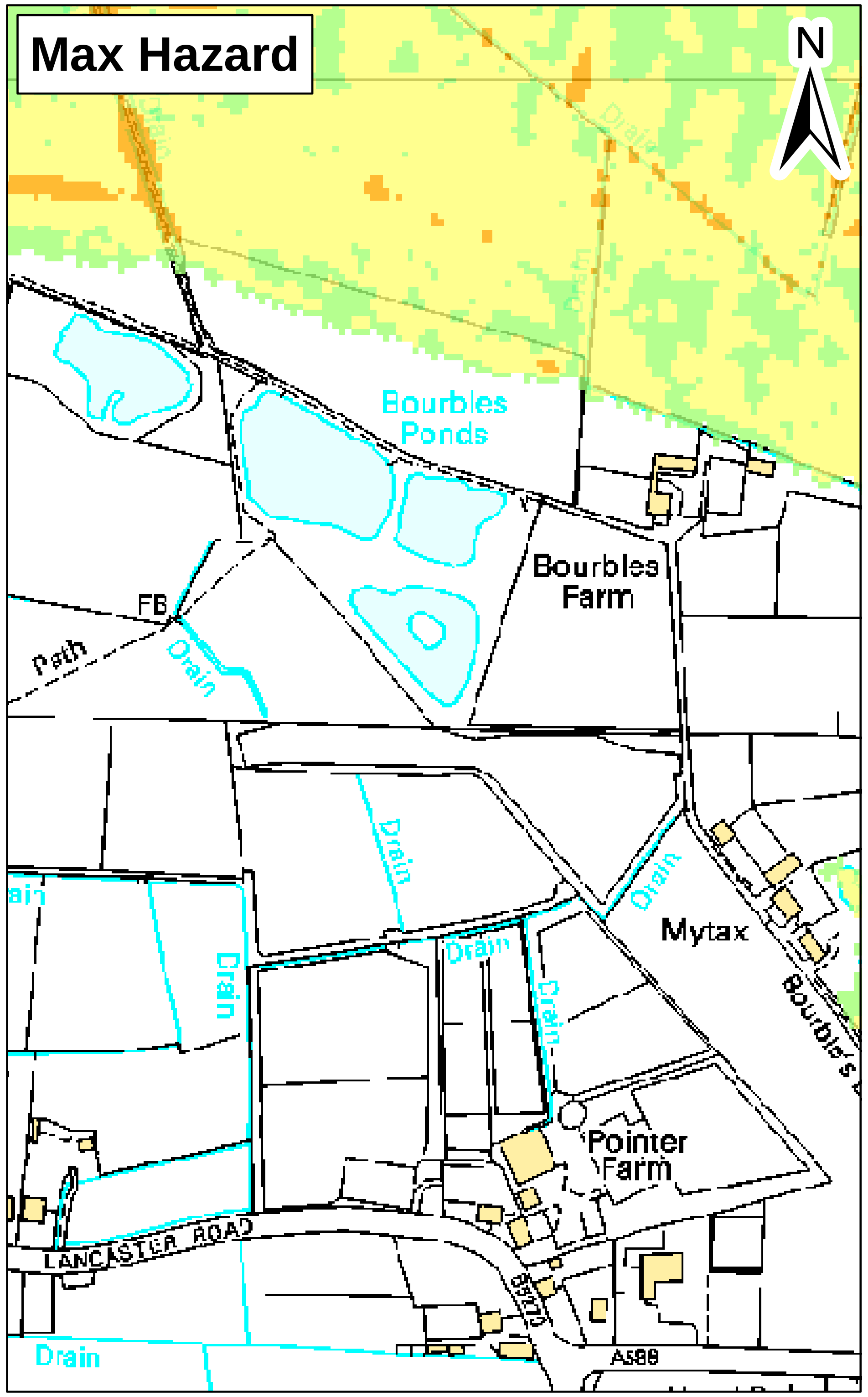
0.5% AEP tidal breach

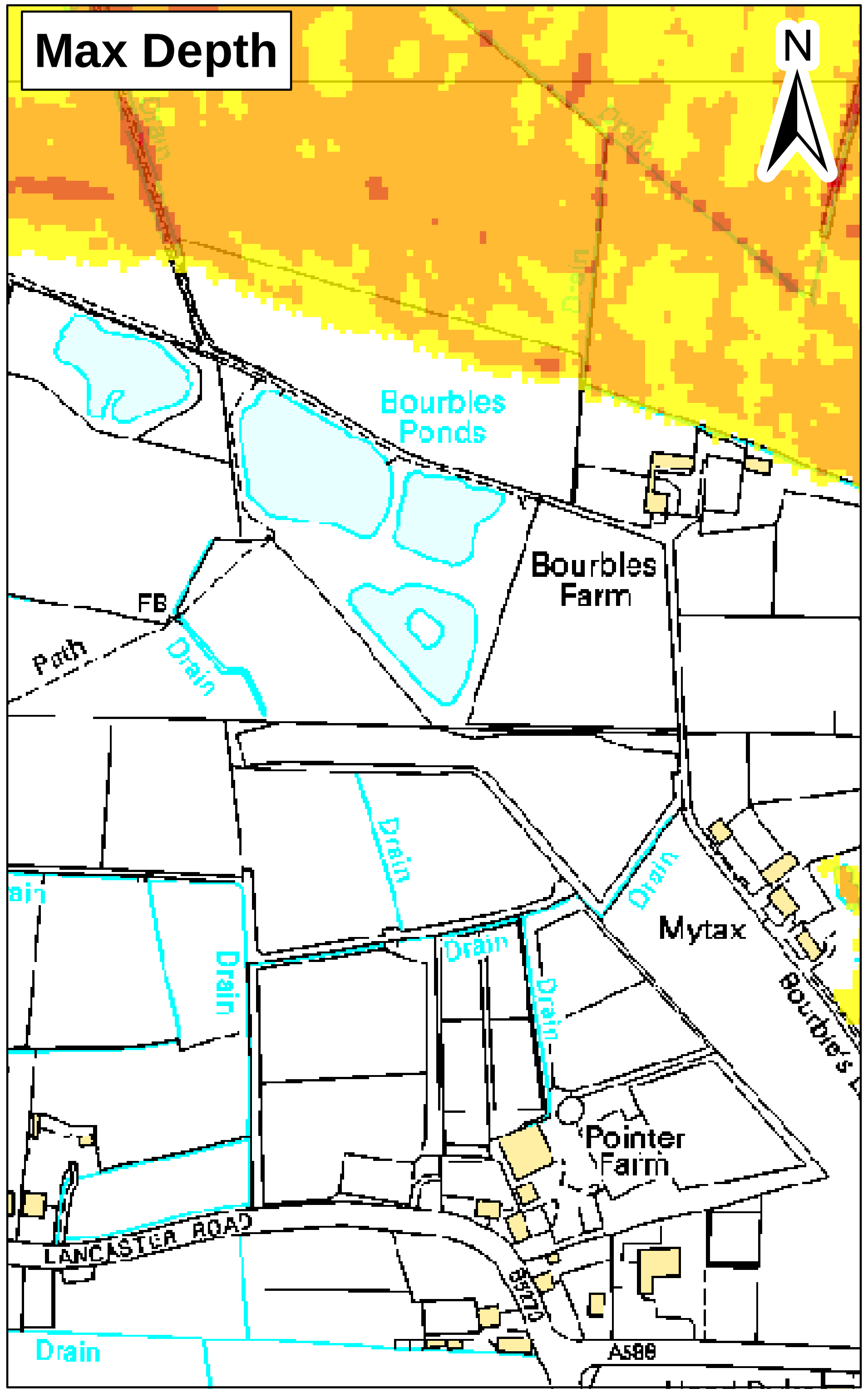
Value

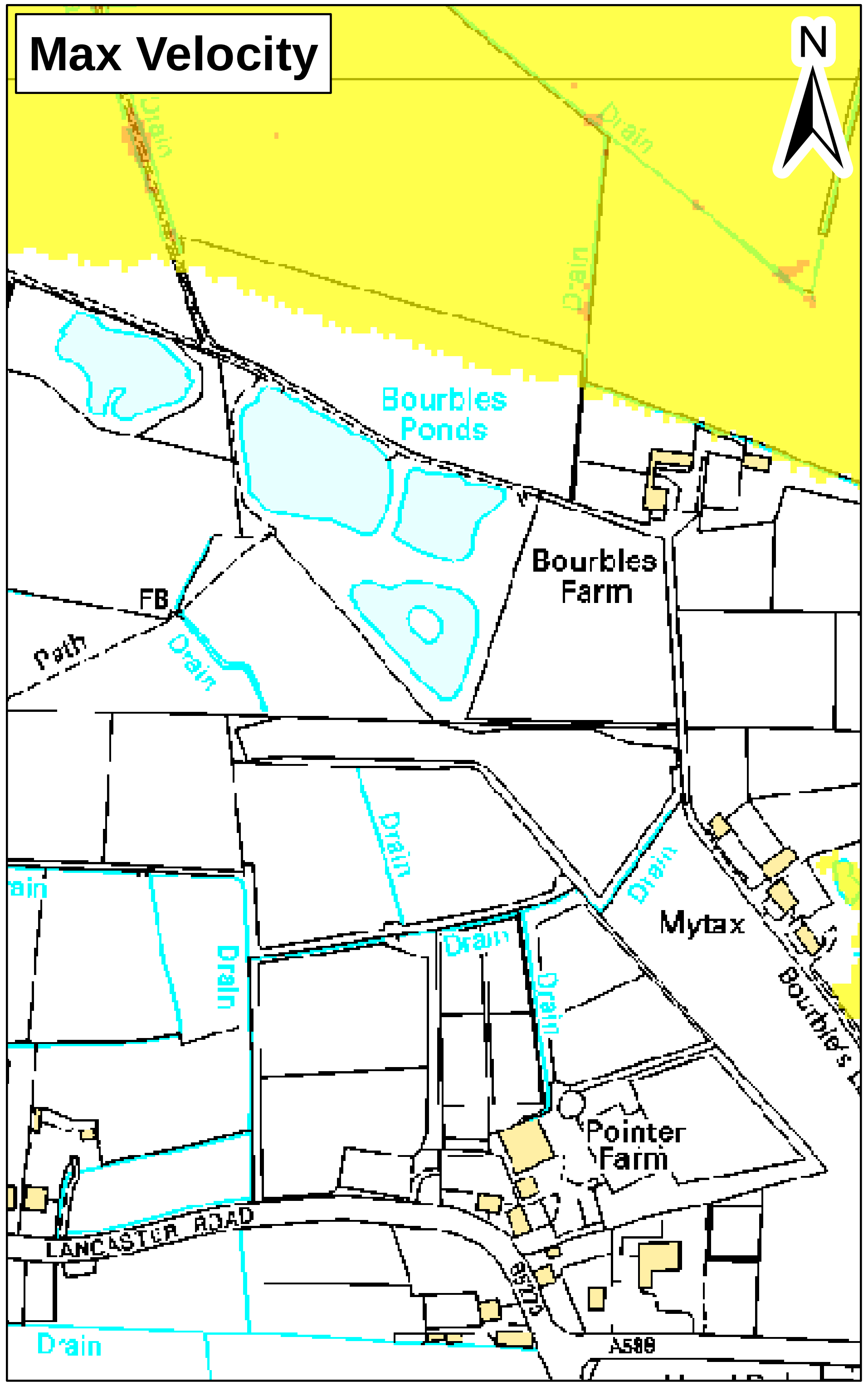
High : 11.8116

Low : 3.6007

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk







Modelled Breach Location

Max Hazard
(Flood Risk to People : FD2320)

- Less than 0.75 (Low Hazard)
- Between 0.75 and 1.25 (Danger for Some)
- Between 1.25 and 2.0 (Danger for Most)
- Greater than 2.0 (Danger for All)

Max Depth (m)

- 0 - 0.25
- 0.25 - 0.50
- 0.50 - 1.0
- 1.0 - 2.0
- 2.0 +

Max Velocity (m/s)

- 0 - 0.3
- 0.3 - 1.0
- 1.0 - 1.5
- 1.5 - 2.5
- 2.5 +

Date Printed	16/09/2021	**Scenario year**	2014	**Scenario Annual Chance**	0.5% (1 in 200)

This map shows the level of flood hazard to people (called a hazard rating) if our flood defences are breached at certain locations, for a range of scenarios. The hazard rating depends on the depth and velocity of floodwater, and maximum values of these are also mapped.

The map is based on computer modelling of simulated breaches at specific locations. Each breach has been modelled individually and the results combined to create this map. Multiple breaches, other combinations of breaches, different sized tidal surges or flood flows may all give different results.

The map only considers the consequences of a breach, it does not make any assumption about the likelihood of a breach occurring. The likelihood of a breach occurring will depend on a number of different factors, including the construction and condition of the defences in the area. A breach is less likely where defences are of a good standard, but a risk of breaching remains.

Please contact the Environment Agency for further information on emergency planning associated with flood risk in this area

Environment Agency

Northern Area Tidal Hazard Mapping: Preesall

Produced: 16/09/2021
Our Ref: CL232740
NGR: 337706, 447596

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

APPENDIX 3133/FRA/A9

Surface water run-off calculation record

hrwallingford

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Chris Ainscow
Site name:	Bourbles Farm
Site location:	Preesall

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	53.92198° N
Longitude:	2.95253° W
Reference:	2797662756
Date:	Jun 01 2023 15:11

Runoff estimation approach: IH124

Site characteristics

Total site area (ha): 15.3

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	2	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.3	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm):	940	940
Hydrological region:	10	10
Growth curve factor 1 year:	0.87	0.87
Growth curve factor 30 years:	1.7	1.7
Growth curve factor 100 years:	2.08	2.08
Growth curve factor 200 years:	2.37	2.37

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

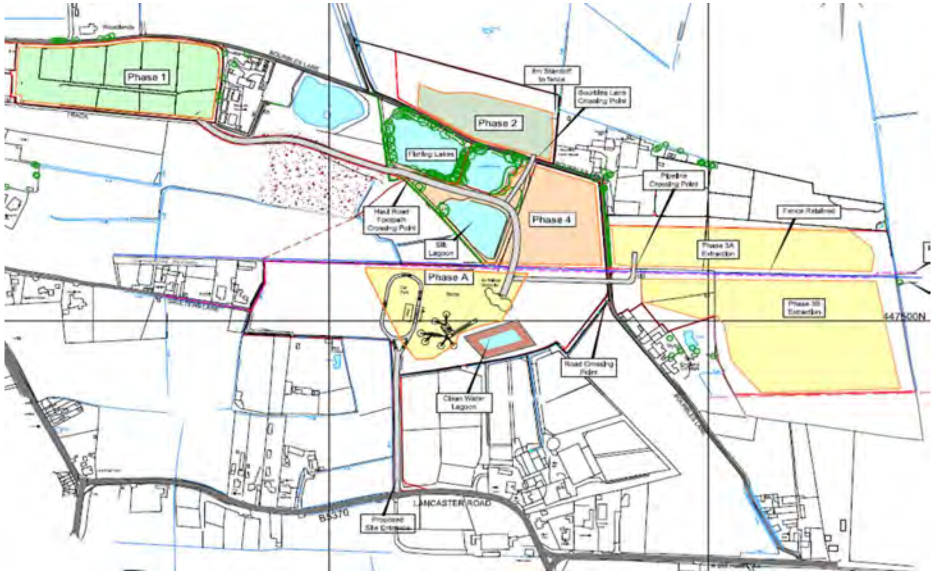
Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	39.37	104.29
1 in 1 year (l/s):	34.25	90.73
1 in 30 years (l/s):	66.93	177.29
1 in 100 year (l/s):	81.89	216.92
1 in 200 years (l/s):	93.3	247.17



	Qbar l/s/ha	Q1	Q30	Q100
site unit runoff	6.8	5.9	11.6	14.2

	void space	excl plant Qbar l/s	incl plant Qbar l/s	Q1	Q30	Q100
Phase A	1.70	11.6	11.6	10.1	19.7	24.1
Plant area	2.20	15.0	26.6	13.0	25.5	31.2
Phase 1	2.40	16.4	31.4	14.2	27.8	34.0
Phase 2	1.00	6.8	21.8	5.9	11.6	14.2
Phase 3a	1.90	13.0	27.9	11.3	22.0	26.9
Phase 3b	3.70	25.2	40.2	21.9	42.8	52.5
Phase 4	2.40	16.4	31.4	14.2	27.8	34.0

	Quarry Void	Plant Area
Runoff Coefficient	0.55	0.70
Area Ha	2.4	2.17

Climate change (% rainfall increase)	40	%

The Rational Method to give peak flow Q_p is in the form:

$$Q_p = 2.78\ CiA$$

Where:

C co-efficient of run-off (dimensionless)
i rainfall intensity (mm/hr)
A catchment area (Ha)

QBar Greenfield Discharge Constraint 26.6 l/s

	Rainfall *2	Rainfall intensity	Runoff from quarry void *3	Runoff from plant area *3	total runoff to be managed *3	Qbar discharge to watercourse	Net runoff to be stored	Net volume in storage
Duration	**100 year event**							
hours	mm	mm/hr	l/s	l/s	l/s	l/s	l/s	m^3
0.25	21.3	85.3	438	504	942	-27	916	824
0.5	29.6	59.3	305	350	655	-27	628	1131
1	39.1	39.1	201	231	432	-27	406	1460
2	49.9	25.0	128	148	276	-27	249	1795
4	63.4	15.9	81	94	175	-27	149	2141
6	71.9	12.0	62	71	132	-27	106	2284
8	77.8	9.7	50	57	107	-27	81	2328
12	85.9	7.2	37	42	79	-27	52	2267
16	91.4	5.7	29	34	63	-27	37	2104
20	95.5	4.8	25	28	53	-27	26	1885
24	98.8	4.1	21	24	46	-27	19	1634
28	101.6	3.6	19	21	40	-27	14	1362
32	104.1	3.3	17	19	36	-27	9	1079
36	106.4	3.0	15	17	33	-27	6	788
40	108.6	2.7	14	16	30	-27	3	492
44	110.7	2.5	13	15	28	-27	1	191
48	112.7	2.3	12	14	26	-27	-1	-113

*2 Obtained from FEH CD-ROM v3

*3 Climate change factored into rainfall intensity at this stage

hafrenwater environmental water management
Barkers Chambers
Barker Street
Shrewsbury, Shropshire SY1 1SB
UK
Tel: 01743 355770
www.hafrenwater.com

Client:

Title: 1 in 100-year plus CC runoff rates and long-term storage requirement for Phase 1

Project: Bourbles Farm Quarry

Calc Sheet: A2

Date: Jun-23

	Quarry Void	Plant Area
Runoff Coefficient	0.55	0.70
Area Ha	1	2.17

Climate change (% rainfall increase)	40	%

QBar Greenfield Discharge Constraint 31.4 l/s

	Rainfall *2	Rainfall intensity	Runoff from quarry void *3	Runoff from plant area *3	total runoff to be managed *3	Qbar discharge to watercourse	Net runoff to be stored	Net volume in storage
Duration	**100 year event**							
hours	mm	mm/hr	l/s	l/s	l/s	l/s	l/s	m^3
0.25	21.3	85.3	183	504	687	-31	655	590
0.5	29.6	59.3	127	350	477	-31	446	803
1	39.1	39.1	84	231	315	-31	284	1021
2	49.9	25.0	53	148	201	-31	170	1222
4	63.4	15.9	34	94	128	-31	96	1388
6	71.9	12.0	26	71	96	-31	65	1406
8	77.8	9.7	21	57	78	-31	47	1351
12	85.9	7.2	15	42	58	-31	26	1134
16	91.4	5.7	12	34	46	-31	15	843
20	95.5	4.8	10	28	38	-31	7	511
24	98.8	4.1	9	24	33	-31	2	156
28	101.6	3.6	8	21	29	-31	-2	-215
32	104.1	3.3	7	19	26	-31	-5	-594
36	106.4	3.0	6	17	24	-31	-8	-978
40	108.6	2.7	6	16	22	-31	-9	-1367
44	110.7	2.5	5	15	20	-31	-11	-1758
48	112.7	2.3	5	14	19	-31	-12	-2153

*2 Obtained from FEH CD-ROM v3

*3 Climate change factored into rainfall intensity at this stage

The Rational Method to give peak flow Q_p is in the form:

$$Q_p = 2.78\ CiA$$

Where:

C co-efficient of run-off (dimensionless)
i rainfall intensity (mm/hr)
A catchment area (Ha)

hafrenwater environmental water management
Barkers Chambers
Barker Street
Shrewsbury, Shropshire SY1 1SB
UK
Tel: 01743 355770
www.hafrenwater.com

Client:			
Title:	1 in 100-year plus CC runoff rates and long-term storage requirement for Phase 2		
Project:	Bourbles Farm Quarry		
Calc Sheet:	A2	Date:	Jun-23

	Quarry Void	Plant Area
Runoff Coefficient	0.55	0.70
Area Ha	1.9	2.20

Climate change (% rainfall increase)	40	%

The Rational Method to give peak flow Q_p is in the form:

$$Q_p = 2.78\ CiA$$

Where:

C co-efficient of run-off (dimensionless)
i rainfall intensity (mm/hr)
A catchment area (Ha)

QBar Greenfield Discharge Constraint 21.8 l/s

	Rainfall *2	Rainfall intensity	Runoff from quarry void *3	Runoff from plant area *3	total runoff to be managed *3	Qbar discharge to watercourse	Net runoff to be stored	Net volume in storage
Duration	**100 year event**							
hours	mm	mm/hr	l/s	l/s	l/s	l/s	l/s	m^3
0.25	21.3	85.3	347	511	858	-22	836	753
0.5	29.6	59.3	241	355	596	-22	575	1034
1	39.1	39.1	159	234	393	-22	372	1338
2	49.9	25.0	102	150	251	-22	229	1651
4	63.4	15.9	65	95	160	-22	138	1984
6	71.9	12.0	49	72	120	-22	99	2132
8	77.8	9.7	40	58	98	-22	76	2188
12	85.9	7.2	29	43	72	-22	50	2167
16	91.4	5.7	23	34	57	-22	36	2054
20	95.5	4.8	19	29	48	-22	26	1889
24	98.8	4.1	17	25	41	-22	20	1695
28	101.6	3.6	15	22	37	-22	15	1482
32	104.1	3.3	13	20	33	-22	11	1258
36	106.4	3.0	12	18	30	-22	8	1028
40	108.6	2.7	11	16	27	-22	6	792
44	110.7	2.5	10	15	25	-22	3	553
48	112.7	2.3	10	14	24	-22	2	311

*2 Obtained from FEH CD-ROM v3

*3 Climate change factored into rainfall intensity at this stage

hafrenwater environmental water management

Barkers Chambers
Barker Street
Shrewsbury, Shropshire SY1 1SB
UK
Tel: 01743 355770
www.hafrenwater.com

Client:

Title: 1 in 100-year plus CC runoff rates and long-term storage requirement for Phase 3A

Project: Bourbles Farm Quarry

Calc Sheet: A2 Date: Jun-23

	Quarry Void	Plant Area
Runoff Coefficient	0.55	0.70
Area Ha	3.7	2.17

Climate change (% rainfall increase)	40	%

The Rational Method to give peak flow Q_p is in the form:

$$Q_p = 2.78\ CiA$$

Where:

C co-efficient of run-off (dimensionless)
i rainfall intensity (mm/hr)
A catchment area (Ha)

QBar Greenfield Discharge Constraint	40.2	l/s

	Rainfall *2	Rainfall intensity	Runoff from quarry void *3	Runoff from plant area *3	total runoff to be managed *3	Qbar discharge to watercourse	Net runoff to be stored	Net volume in storage
Duration	**100 year event**							
hours	mm	mm/hr	l/s	l/s	l/s	l/s	l/s	m^3
0.25	21.3	85.3	675	504	1,180	-40	1139	1025
0.5	29.6	59.3	470	350	820	-40	780	1404
1	39.1	39.1	310	231	541	-40	501	1803
2	49.9	25.0	198	148	345	-40	305	2197
4	63.4	15.9	126	94	219	-40	179	2580
6	71.9	12.0	95	71	166	-40	125	2710
8	77.8	9.7	77	57	134	-40	94	2714
12	85.9	7.2	57	42	99	-40	59	2538
16	91.4	5.7	45	34	79	-40	39	2234
20	95.5	4.8	38	28	66	-40	26	1860
24	98.8	4.1	33	24	57	-40	17	1447
28	101.6	3.6	29	21	50	-40	10	1006
32	104.1	3.3	26	19	45	-40	5	552
36	106.4	3.0	23	17	41	-40	1	88
40	108.6	2.7	22	16	38	-40	-3	-383
44	110.7	2.5	20	15	35	-40	-5	-859
48	112.7	2.3	19	14	32	-40	-8	-1340

*2 Obtained from FEH CD-ROM v3

*3 Climate change factored into rainfall intensity at this stage

hafrenwater environmental water management
Barkers Chambers
Barker Street
Shrewsbury, Shropshire SY1 1SB
UK
Tel: 01743 355770
www.hafrenwater.com

Client:			
Title:	1 in 100-year plus CC runoff rates and long-term storage requirement for Phase 3B		
Project:	Bourbles Farm Quarry		
Calc Sheet:	A2	Date:	Jun-23

	Quarry Void	Plant Area
Runoff Coefficient	0.55	0.70
Area Ha	3.2	2.17

Climate change (% rainfall increase)	40	%

The Rational Method to give peak flow Q_p is in the form:

$$Q_p = 2.78\ CiA$$

Where:

C	co-efficient of run-off (dimensionless)
i	rainfall intensity (mm/hr)
A	catchment area (Ha)

QBar Greenfield Discharge Constraint 31.4 l/s

Duration	Rainfall *[2]	Rainfall intensity	Runoff from quarry void *[3]	Runoff from plant area *[3]	total runoff to be managed *[3]	Qbar discharge to watercourse	Net runoff to be stored	Net volume in storage
	100 year event							
hours	mm	mm/hr	l/s	l/s	l/s	l/s	l/s	m^3
0.25	21.3	85.3	584	504	1,088	-31	1057	951
0.5	29.6	59.3	406	350	757	-31	725	1305
1	39.1	39.1	268	231	499	-31	468	1684
2	49.9	25.0	171	148	319	-31	287	2068
4	63.4	15.9	109	94	202	-31	171	2463
6	71.9	12.0	82	71	153	-31	121	2624
8	77.8	9.7	67	57	124	-31	93	2669
12	85.9	7.2	49	42	91	-31	60	2590
16	91.4	5.7	39	34	73	-31	42	2393
20	95.5	4.8	33	28	61	-31	30	2130
24	98.8	4.1	28	24	53	-31	21	1831
28	101.6	3.6	25	21	46	-31	15	1508
32	104.1	3.3	22	19	42	-31	10	1171
36	106.4	3.0	20	17	38	-31	6	826
40	108.6	2.7	19	16	35	-31	3	474
44	110.7	2.5	17	15	32	-31	1	118
48	112.7	2.3	16	14	30	-31	-1	-243

*[2] Obtained from FEH CD-ROM v3

*[3] Climate change factored into rainfall intensity at this stage

hafrenwater environmental water management
Barkers Chambers
Barker Street
Shrewsbury, Shropshire SY1 1SB
UK
Tel: 01743 355770
www.hafrenwater.com

Client:			
Title:	1 in 100-year plus CC runoff rates and long-term storage requirement for Phase 4		
Project:	Bourbles Farm Quarry		
Calc Sheet:	A2	Date:	Jun-23

	Quarry Void	Plant Area
Runoff Coefficient	0.55	0.70
Area Ha	1.7	

Climate change (% rainfall increase)	40	%

The Rational Method to give peak flow Q_p is in the form:

$$Q_p = 2.78\ CiA$$

Where:

C co-efficient of run-off (dimensionless)
i rainfall intensity (mm/hr)
A catchment area (Ha)

QBar Greenfield Discharge Constraint 11.6 l/s

Duration	Rainfall *2	Rainfall intensity	Runoff from quarry void *3	Runoff from plant area *3	total runoff to be managed *3	Qbar discharge to watercourse	Net runoff to be stored	Net volume in storage
	100 year event							
hours	mm	mm/hr	l/s	l/s	l/s	l/s	l/s	m^3
0.25	21.3	85.3	310	0	310	-12	299	269
0.5	29.6	59.3	216	0	216	-12	204	367
1	39.1	39.1	142	0	142	-12	131	471
2	49.9	25.0	91	0	91	-12	79	571
4	63.4	15.9	58	0	58	-12	46	664
6	71.9	12.0	44	0	44	-12	32	691
8	77.8	9.7	35	0	35	-12	24	685
12	85.9	7.2	26	0	26	-12	14	624
16	91.4	5.7	21	0	21	-12	9	530
20	95.5	4.8	17	0	17	-12	6	417
24	98.8	4.1	15	0	15	-12	3	294
28	101.6	3.6	13	0	13	-12	2	163
32	104.1	3.3	12	0	12	-12	0	29
36	106.4	3.0	11	0	11	-12	-1	-107
40	108.6	2.7	10	0	10	-12	-2	-246
44	110.7	2.5	9	0	9	-12	-2	-386
48	112.7	2.3	9	0	9	-12	-3	-527

*2 Obtained from FEH CD-ROM v3

*3 Climate change factored into rainfall intensity at this stage

hafrenwater environmental water management
Barkers Chambers
Barker Street
Shrewsbury, Shropshire SY1 1SB
UK
Tel: 01743 355770
www.hafrenwater.com

Client:

Title:	1 in 100-year plus CC runoff rates and long-term storage requirement for Phase A		
Project:	Bourbles Farm Quarry		
Calc Sheet:	A2	Date:	Jun-23