# Land adjacent to 93 Market Street, Millom, Cumbria, LA18 4AJ

# NPPF: Flood Risk Assessment

For Camilla Fallows

KRS.0649.001.R.001.A

May 2022

www.krsenvironmental.com

## CONTACT DETAILS

Registered Office:
KRS Environmental Ltd
3 Princes Square
Princes Street
Montgomery
Powys
SY15 6PZ

Office also at:
KRS Environmental Ltd
The Media Centre
7 Northumberland Street
Huddersfield
West Yorkshire
HD1 1RL

Web: www.krsenvironmental.com
LinkedIn: uk.linkedin.com/in/keelanserjeant/

| Land adjacent to 93 Market Street, Millom, Cumbria, LA18 4AJ | |
|---|---|
| Project | NPPF: Flood Risk Assessment |
| Client | Camilla Fallows |
| Status | Final |
| Prepared by | Ruth Evans |
| Reviewed by | Keelan Serjeant BSc (Hons), MSc |
| Date | May 2022 |

**Disclaimer**:

This report has been produced by KRS Environmental Limited within the terms of the contract with the client and taking account of the resources devoted to it by agreement with the client.

We disclaim any responsibility to the client and others in respect of any matters outside the scope of the above.

This report is confidential to the client and we accept no responsibility of whatsoever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies on the report at their own risk.

# CONTENTS

**CONTENTS** ....... i
**TABLES & FIGURES** ....... iii
**EXECUTIVE SUMMARY** ....... iv
**1.0 INTRODUCTION** ....... 1
1.1 Background ....... 1
1.2 National Planning Policy Framework (NPPF) ....... 1
1.3 Report Structure ....... 1
**2.0 LOCATION & DEVELOPMENT DESCRIPTION** ....... 3
2.1 Site Location ....... 3
2.2 Existing Development ....... 3
2.3 Proposed Development ....... 3
2.4 Site Access ....... 3
2.5 Ground Levels ....... 3
2.6 Catchment Hydrology ....... 4
2.7 Ground Conditions ....... 4
**3.0 FLOOD RISK** ....... 5
3.1 Sources of Flooding ....... 5
3.2 Environment Agency Data ....... 5
3.3 Historic Flooding ....... 5
3.4 Existing and Planned Flood Defence Measures ....... 5
3.5 Environment Agency Flood Zones ....... 5
3.6 Flood Risk Vulnerability ....... 6
3.7 Climate Change ....... 7
3.8 Fluvial (river) Flooding ....... 8
3.9 Tidal (coastal) Flooding ....... 8
3.10 Groundwater Flooding ....... 13
3.11 Surface Water (pluvial) Flooding ....... 13
3.12 Sewer Flooding ....... 14
3.13 Flooding from Artificial Drainage Systems/Infrastructure Failure ....... 15
3.14 Effect of the Development on Flood Risk ....... 15
3.15 Summary Site Specific Flood Risk Assessment ....... 16
**4.0 SURFACE WATER DRAINAGE** ....... 18
4.1 Surface Water Management Overview ....... 18
4.2 Climate Change ....... 18
4.3 Greenfield Runoff Rates ....... 18
4.4 Opportunities for Discharge of Surface Water ....... 19
4.5 Soakaway / Infiltration System ....... 19
4.6 Watercourse ....... 19
4.7 Sewer ....... 19
4.8 SuDS and Water Quality ....... 19
4.9 Proposed SuDS Strategy ....... 23
4.10 Designing for Local Drainage System Failure/Design Exceedance ....... 24
**5.0 RISK MANAGEMENT** ....... 26
5.1 Introduction ....... 26
5.2 Finished Floor Level ....... 26
5.3 First Floor Accommodation ....... 26
5.4 Flood Resilience and Resistance ....... 26
5.5 Flood Plan ....... 27

5.6 Access and Egress Route ..... 27
5.7 Residual Risk ..... 28
**6.0 SEQUENTIAL APPROACH ..... 29**
6.1 Sequential Test ..... 29
6.2 Exception Test ..... 30
**7.0 SUMMARY AND CONCLUSIONS ..... 32**
7.1 Introduction ..... 32
7.2 Flood Risk ..... 32
7.3 SuDS Strategy ..... 33
7.4 Risk Management ..... 34
7.5 Sequential Approach ..... 35
7.6 Conclusion ..... 35
**APPENDICES ..... 36**
APPENDIX 1 – Proposed Site Layout ..... 37
APPENDIX 2 – Environment Agency Data ..... 38
APPENDIX 3 – Surface Water Drainage Calculations ..... 39

## TABLES & FIGURES

Figure 1 - Site Location ........ 3
Figure 2 - Environment Agency Flood Zones ........ 6
Table 1 - Environment Agency Flood Zones and Appropriate Land Use ........ 7
Table 2 - Flood Risk Vulnerability and Flood Zone 'Compatibility' ........ 7
Table 3 - Peak River Flow Allowances by Catchment (use 1961 to 1990 baseline) ........ 8
Table 4 - Sea Level Allowances by Area for Each Epoch (mm per year) (based on a 1981 to 2000 baseline) ........ 8
Table 5 - Environment Agency Defended Modelled Tidal Water Levels (mAOD) ........ 9
Table 6 - Environment Agency Defended Modelled Tidal Water Depths (m) ........ 9
Figure 3 - Environment Agency Defended Modelled 1 in 1000 Year Flood Outline ........ 9
Figure 4 - Environment Agency Defended Climate Change Modelled 1 in 200 Year (plus climate change) Flood Outline ........ 10
Table 7 - Environment Agency Undefended Modelled Tidal Water Levels (mAOD) ........ 11
Table 8 - Environment Agency Undefended Modelled Tidal Water Depths (m) ........ 11
Figure 5 - Environment Agency Undefended Modelled 1 in 1000 Year Flood Outline ........ 12
Figure 6 - Environment Agency Undefended 1 in 200 Year (plus climate change) Flood Outline ........ 12
Figure 7 - Environment Agency Surface Water Flood Risk Map ........ 14
Figure 8 - Environment Agency Reservoir Flood Risk Map ........ 15
Table 9 - Risk Posed by Flooding Sources ........ 16
Table 10 - Peak Rainfall Intensity Allowance in Small and Urban Catchment (use 1961 to 1990 baseline) ........ 18
Table 11 - IoH124 Method Greenfield Runoff Rates ........ 19
Table 12 - Sustainability Hierarchy ........ 21
Table 13 - SuDS Techniques ........ 22
Figure 9 - Safe Access and Egress Route ........ 28

# EXECUTIVE SUMMARY

The proposed development would be expected to remain dry in all but the most extreme conditions. Providing the recommendations made in this FRA are instigated, flood risk from all sources would be minimised, the consequences of flooding are acceptable, and the development would be in accordance with the requirements of the NPPF.

This FRA demonstrates that the proposed development would be operated with minimal risk from flooding, would not increase flood risk elsewhere and is compliant with the requirements of the NPPF. The development should not therefore be precluded on the grounds of flood risk.

# 1.0 INTRODUCTION

## 1.1 Background

This Flood Risk Assessment (FRA) has been prepared by KRS Environmental Limited at the request of Camilla Fallows to support a planning application for the proposed development at land adjacent to 93 Market Street, Millom, Cumbria, LA18 4AJ. This FRA includes an assessment of the existing and proposed surface water drainage of the site.

This FRA has been carried out in accordance with guidance contained in the National Planning Policy Framework (NPPF)[1] and associated Planning Practice Guidance[2]. This FRA identifies and assesses the risks of all forms of flooding to and from the development and demonstrates how these flood risks will be managed so that the development remains safe throughout the lifetime, taking climate change into account.

It is recognised that developments which are designed without regard to flood risk may endanger lives, damage property, cause disruption to the wider community, damage the environment, be difficult to insure and require additional expense on remedial works. The development design should be such that future users will not have difficulty obtaining insurance or mortgage finance, or in selling all or part of the development, as a result of flood risk issues.

## 1.2 National Planning Policy Framework (NPPF)

One of the key aims of the NPPF is to ensure that flood risk is taken into account at all stages of the planning process; to avoid inappropriate development in areas at risk of flooding and to direct development away from areas of highest risk.

It advises that where new development is exceptionally necessary in areas of higher risk, this should be safe, without increasing flood risk elsewhere, and where possible, reduce flood risk overall. A risk based approach is adopted at stages of the planning process, applying a source pathway receptor model to planning and flood risk. To demonstrate this, an FRA is required and should include:

- whether a proposed development is likely to be affected by current or future flooding from all sources;
- whether it will increase flood risk elsewhere;
- whether the measures proposed to deal with these effects and risks are appropriate;
- if necessary provide the evidence to the LPA that the Sequential Test can be applied; and
- whether the development will be safe and pass part c) of the Exception Test if this is appropriate.

## 1.3 Report Structure

This FRA has the following report structure:

- Section 2 describes the location area and the existing and proposed development;
- Section 3 outlines the flood risk to the existing and proposed development;

Department for Communities and Local Government (2021) National Planning Policy Framework.
[2] Communities and Local Government (2014) Planning Practice Guidance - Flood Risk and Coastal Change.

- Section 4 details the proposed surface water drainage for the site and assesses the potential impacts of the proposed development on surface water drainage;
- Section 5 outlines mitigation measures used to reduce the overall level of flood risk;
- Section 6 details the sequential and exception tests; and
- Section 7 presents a summary and conclusions.

# 2.0 LOCATION & DEVELOPMENT DESCRIPTION

## 2.1 Site Location

The site is located at land adjacent to 93 Market Street, Millom, Cumbria, LA18 4AJ (see Figure 1).

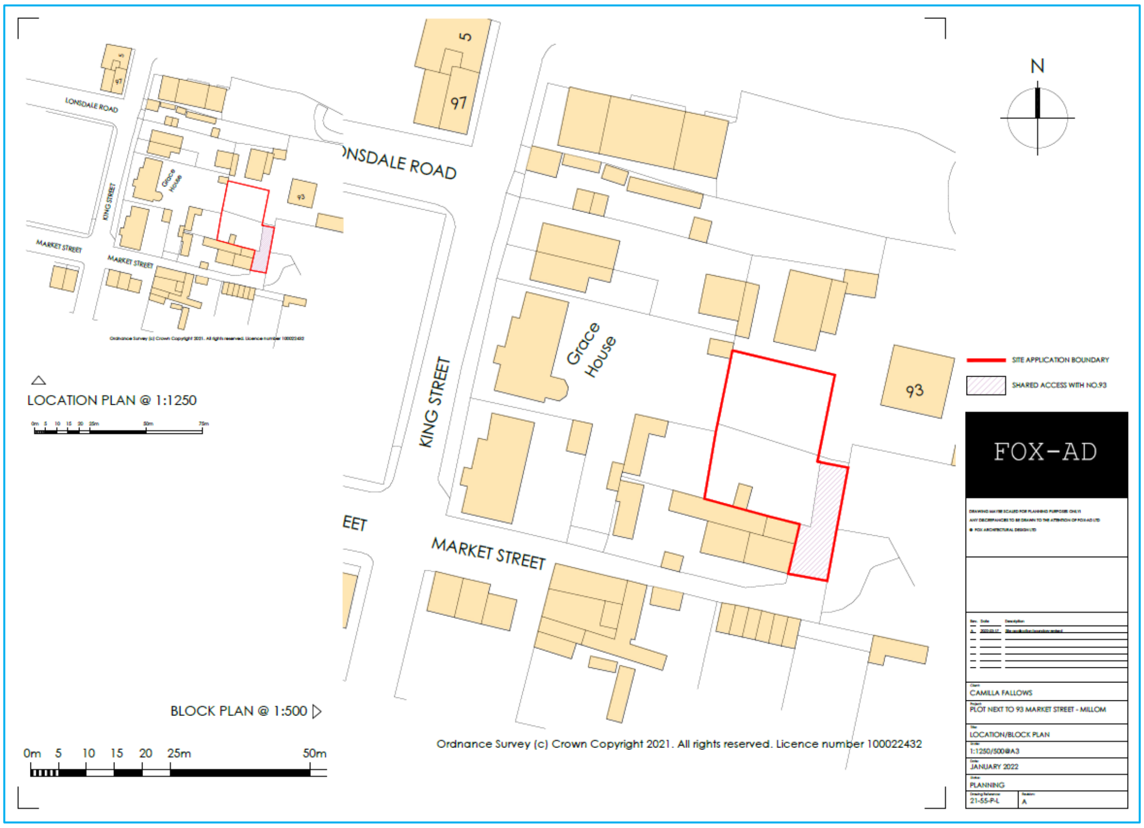



**Figure 1 - Site Location**

## 2.2 Existing Development

The current site consists of a parcel of garden land formerly associated with 93 Market Street.

## 2.3 Proposed Development

It is understood that the proposals are for the erection of a 4 bedroom detached house with off road parking (see Appendix 1). Further details with regard to the proposed development can be found in the accompanying information submitted with the planning application.

## 2.4 Site Access

The vehicle access to the site is via the access road off of King Street. The existing driveway serving as access to 93 Market Street will be retained and shared with the proposed new dwelling.

## 2.5 Ground Levels

The site falls from north east to south west with an approximate ground level to the south west of 5.29 metres Above Ordnance Datum (mAOD) increasing to approximately 5.60mAOD to the north east corner of the site as shown the Ordnance Survey Datum Digital Terrain Model (DTM).

### 2.6 Catchment Hydrology

The Salthouse Pool is located approximately 258m to the north of the site and ultimately discharges into the Duddon Sands, which is part of the Duddon Estuary and is located approximately 1.20km to the east of the site which then flows into the Duddon Channel. The Outer Barrier, an extensive manmade lagoon, is located approximately 1.20km to the south of the site.

### 2.7 Ground Conditions

The British Geological Survey (BGS) Map[3] indicates that the bedrock underlying the site consists of the Low Furness Basal Formation - conglomerate and [subequal/subordinate] sandstone, interbedded. Sedimentary Bedrock formed approximately 345 to 359 million years ago in the Carboniferous Period in a local environment previously dominated by rivers. The superficial deposits underlying the site consist of raised Marine Deposits - sand and gravel. Superficial deposits formed up to 3 million years ago in the Quaternary Period in a local environment previously dominated by shallow seas (U). Information from the National Soil Resource Institute[4] details the site area as being situated on loamy and clayey soils of coastal flats with naturally high groundwater.

The Environment Agency has designated the bedrock deposits as Secondary A Aquifers - 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. These are generally aquifers formerly classified as minor aquifers.

The site is not located within an Environment Agency Source Protection Zone.

[3] https://mapapps2.bgs.ac.uk/geoindex/home.html
[4] https://www.landis.org.uk/soilscapes/

# 3.0 FLOOD RISK

## 3.1 Sources of Flooding

All sources of flooding have been considered, these are; fluvial (river) flooding, tidal (coastal) flooding, groundwater flooding, surface water (pluvial) flooding, sewer flooding and flooding from artificial drainage systems/infrastructure failure.

## 3.2 Environment Agency Data

Information regarding the current flood risk at the site and local flood defences has been obtained from the Environment Agency (see Appendix 2).

## 3.3 Historic Flooding

The Environment Agency has confirmed that they do not hold any historic flooding data for this site. Cumbria County Council's Flood Investigation Report confirms that on 30th September 2017 an intense rainfall event occurred over Millom and Haverigg. The rain overwhelmed the drainage systems and surface water began to rise, flooding an estimated 255 residential properties. It is however noted that this flood event did not affect the site and the applicant has also confirmed there has been no flooding of the site since they have occupied the 93 Market Street (i.e. the last 40+ years). Therefore, the site will not be during a similar flood event.

There are no records of anecdotal information of flooding at the site. The British Hydrological Society "Chronology of British Hydrological Event[5]" has no information on flooding within the vicinity of the site. No other historical records of flooding for the site have been recorded. Therefore, it has been concluded that the site has not historically flooded in the recent past.

## 3.4 Existing and Planned Flood Defence Measures

The Environment Agency have confirmed this this location is protected by fluvial and tidal formal flood defences (see Figure 2). Further property level protection measures will be used to protect the site from flooding these are discussed in Section 5.0.

## 3.5 Environment Agency Flood Zones

A review of the Environment Agency's Flood Zones indicates that the site is located within Flood Zone 2 (see Figure 2) and therefore has a 'medium probability' of flooding. Flood Zone 2 has between a 1 in 100 and 1 in 1000 annual probability of flooding (1% - 0.1%) in any year.

The Flood Zones are the current best information on the extent of the extremes of flooding from rivers or the sea that would occur <u>without the presence of flood defences</u>, because these can be breached, overtopped and may not be in existence for the lifetime of the development. The Environment Agency Flood Zones and acceptable development types are explained in Table 1. Table 1 shows that most development types are generally acceptable in Flood Zone 2.

[5] https://cbhe.hydrology.org.uk/

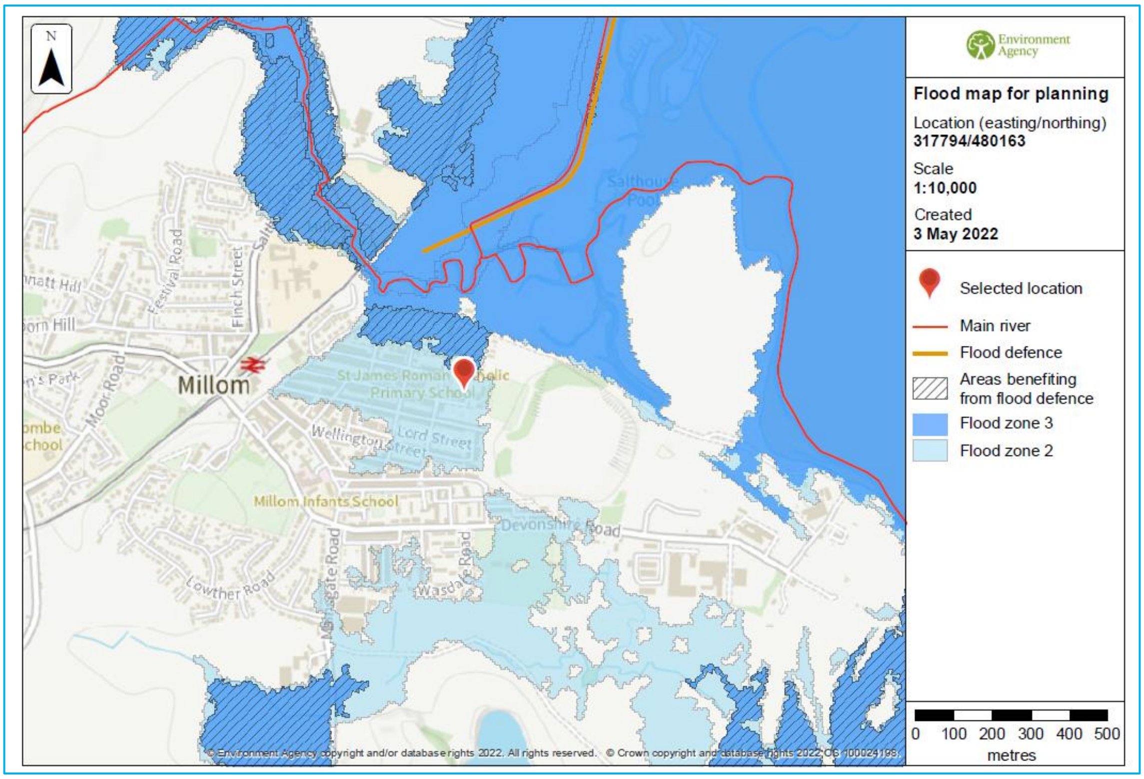



**Figure 2 - Environment Agency Flood Zones**

### 3.6 Flood Risk Vulnerability

In the Planning Practice Guidance to the NPPF, appropriate uses have been identified for the Flood Zones. Applying the Flood Risk Vulnerability Classification in the Planning Practice Guidance in the NPPF, the proposed development for residential uses is classified as 'more vulnerable'.

Tables 1 and 2 of this report and the Planning Practice Guidance state that 'more vulnerable' uses are appropriate within Flood Zones 2 and after the completion of a satisfactory FRA.

**Table 1 - Environment Agency Flood Zones and Appropriate Land Use**

| Flood Zone | Probability | Explanation | Appropriate Land Use |
|---|---|---|---|
| Zone 1 | Low | Less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%) | All development types generally acceptable |
| Zone 2 | Medium | Between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% - 0.1%) in any year | Most development type are generally acceptable |
| Zone 3a | High | A 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year | Some development types not acceptable |
| Zone 3b | 'Functional Floodplain' | Land where water has to be flow or be stored in times of flood. SFRAs should identify this zone (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1% flood, or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes) | Some development types not acceptable |

**Table 2 - Flood Risk Vulnerability and Flood Zone 'Compatibility'**

| Flood Risk Vulnerability Classification | Essential Infrastructure | Water Compatible | Highly Vulnerable | More Vulnerable | Less Vulnerable |
|---|---|---|---|---|---|
| Zone 1 | ✓ | ✓ | ✓ | ✓ | ✓ |
| Zone 2 | ✓ | ✓ | Exception test required | ✓ | ✓ |
| Zone 3a | Exception test required | ✓ | × | Exception test required | ✓ |
| Zone 3b 'Functional Floodplain' | Exception test required | ✓ | × | × | × |

***Key:*** *✓: Development is appropriate, ×: Development should not be permitted.*

### 3.7 Climate Change

Projections of future climate change, in the UK, indicate more frequent, short-duration, high intensity rainfall and more frequent periods of long duration rainfall. Guidance included within the NPPF recommends that the effects of climate change are incorporated into FRA. Recommended precautionary sensitivity ranges for peak rainfall intensities and peak river flows are outlined in the Flood risk assessments: climate change allowances guidance[6].

The flood risk assessments: climate change allowances guidance recommends that for 'more vulnerable' uses in Flood Zone 2 that the central allowances are used to assess climate change throughout the lifetime of the development which is 100 years. Table 3 shows the peak river flow

[6] https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#high-allowances

allowances by river management catchment. Therefore, the fluvial design event for the site is the 1 in 100 year (+30%) event.

The increases in sea level for the North West of England are shown in Table 4. The tidal design event for the site is the 1 in 200 year in 2122 event.

**Table 3 - Peak River Flow Allowances by Catchment (use 1961 to 1990 baseline)**

| River Management Catchment | Allowance Category | 2020s | 2050s | 2080s |
|---|---|---|---|---|
| South West Lakes Management Catchment | Upper | +22% | +38% | +63% |
| | Higher | +14% | +23% | +39% |
| | Central | +12% | +17% | +30% |

**Table 4 - Sea Level Allowances by Area for Each Epoch (mm per year) (based on a 1981 to 2000 baseline)**

| Area of England | Allowance Category | 2000 to 2035 | 2036 to 2065 | 2066 to 2095 | 2096 to 2125 |
|---|---|---|---|---|---|
| North West | High central | 4.50 | 7.30 | 10.00 | 11.20 |
| | Upper end | 5.70 | 9.90 | 14.20 | 16.30 |

### 3.8 Fluvial (river) Flooding

The site is not located within the vicinity of fluvial flooding sources and the risk of fluvial flooding is considered to be **not significant.**

### 3.9 Tidal (coastal) Flooding

The Duddon Sands are located to the east of the site and therefore, the principal flood risk to the site is from tidal flooding.

*Defended Scenario*

Considerable investment has been made in the provision of the flood defences to protect the area from tidal flooding and existing flood defence measures provide protection against tidal flooding and reduce the flood risk to the site. Tables 5 and 6 show the Environment Agency defended tidal water levels and water depths for the site. Node 16 has been used as this is the closest point to the site and Nodes 1, 6, 7 and 8 have been used as this is the access route to the site as shown in Figures 3 and 4.

The modelled water levels have been compared to the minimum ground level of the site. Tables 5 and 6 show that the site will not be inundated with floodwater for all events up to and including the defended 1 in 1000 year event. The site will be flood free during the defended 1 in 1000 year event, as confirmed within Figure 3. The actual flood risk posed to the site is low and is less than 1 in 1000 years.

Water levels have been modelled at 5.57mAOD during the defended 1 in 200 year (plus climate change) event therefore, the site may be inundated with floodwater to a maximum depth of 0.28m, as confirmed within Figure 4.

**Table 5 - Environment Agency Defended Modelled Tidal Water Levels (mAOD)**

| Node Reference | Eastings | Northings | Return Period (yrs) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 20 | 50 | 75 | 100 | 200 | 200 (+600mm Climate Change) | 1000 |
| 1 | 317744 | 480113 | No Data | No Data | No Data | No Data | No Data | No Data | No Data |
| 6 | 317744 | 480138 | No Data | No Data | No Data | No Data | No Data | 5.57 | No Data |
| 7 | 317769 | 480138 | No Data | No Data | No Data | No Data | No Data | No Data | No Data |
| 8 | 317794 | 480138 | No Data | No Data | No Data | No Data | No Data | No Data | No Data |
| 16 | 317744 | 480188 | No Data | No Data | No Data | No Data | No Data | 5.57 | No Data |

**Table 6 - Environment Agency Defended Modelled Tidal Water Depths (m)**

| Node Reference | Eastings | Northings | Return Period (yrs) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 20 | 50 | 75 | 100 | 200 | 200 (+600mm Climate Change) | 1000 |
| 1 | 317744 | 480113 | No Data | No Data | No Data | No Data | No Data | No Data | No Data |
| 6 | 317744 | 480138 | No Data | No Data | No Data | No Data | No Data | 0.14 | No Data |
| 7 | 317769 | 480138 | No Data | No Data | No Data | No Data | No Data | No Data | No Data |
| 8 | 317794 | 480138 | No Data | No Data | No Data | No Data | No Data | No Data | No Data |
| 16 | 317744 | 480188 | No Data | No Data | No Data | No Data | No Data | 0.28 | No Data |

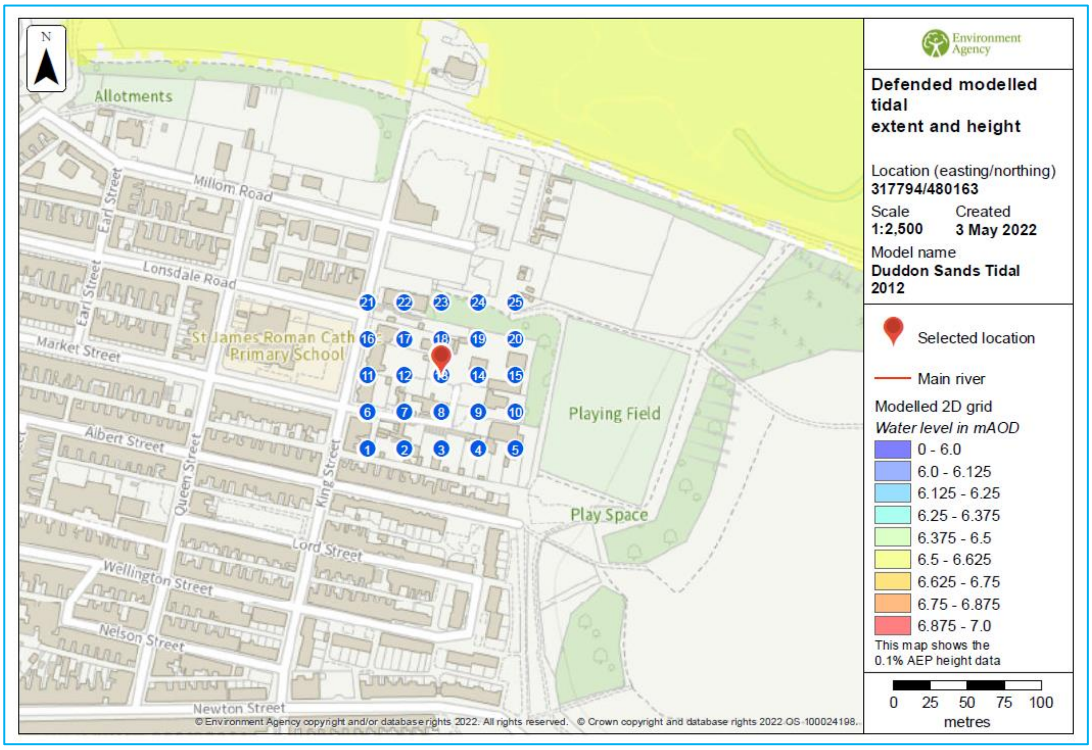



**Figure 3 - Environment Agency Defended Modelled 1 in 1000 Year Flood Outline**

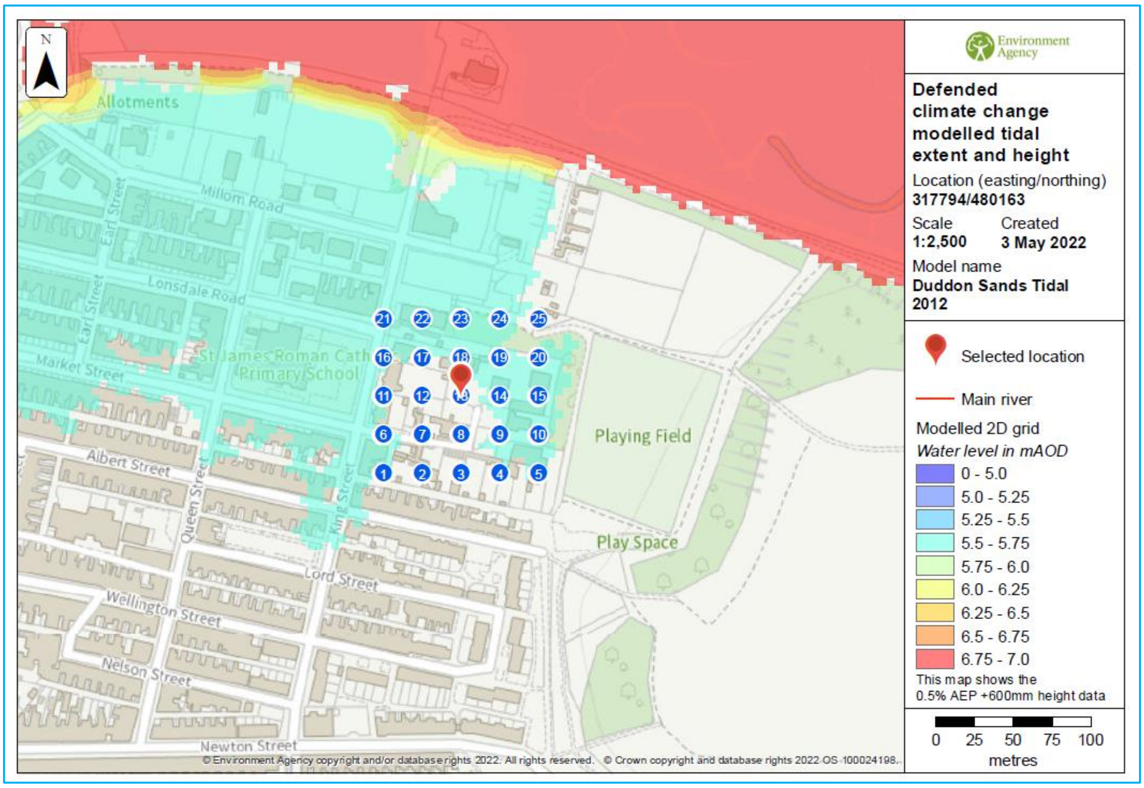



**Figure 4 - Environment Agency Defended Climate Change Modelled 1 in 200 Year (plus climate change) Flood Outline**

*Undefended Scenario*

The flood defences can only protect up to a point, they may malfunction, can be breached and have a finite structure life. Therefore, there is a residual risk of tidal flooding. If the flood defences were not there, the area would be flooded. However, as area of land may benefit from the presence of flood defences even if the flood defences are overtopped, the presence of the flood defences means that the floodwater does not extend as far as it would if the flood defences were not there. It is unlikely that a breach in the flood defences would occur.

Tables 7 and 8 show the Environment Agency undefended water levels and water depths. Node 16 has been used as this is the closest point to the site and Nodes 1, 6, 7 and 8 have been used as this is the access route to the site as shown in Figures 5 and 6. Figures 7 and 8 shows the undefended tidal modelled outlines and confirm that the site would be inundated with floodwater.

The modelled water levels have been compared to the minimum ground level of the site. Tables 7 and 8 show that the site will not be inundated with floodwater for all events up to and including the undefended 1 in 200 year event. The site will be flood free during the undefended 1 in 200 year event, as confirmed within Figure 5. The residual flood risk posed to the site is low and is less than 1 in 200 years.

Water levels have been modelled at 6.93mAOD during the undefended 1 in 200 year (plus climate change) event therefore, the site may be inundated with floodwater to a maximum depth of 1.65m. and during the undefended 1 in 1000 year event a maximum depth of 0.51m would be experienced.

**Table 7 - Environment Agency Undefended Modelled Tidal Water Levels (mAOD)**

| Node Reference | Eastings | Northings | Return Period (yrs) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 20 | 50 | 75 | 100 | 200 | 200 (+600mm Climate Change) | 1000 |
| 1 | 317744 | 480113 | No Data | No Data | No Data | No Data | No Data | 6.89 | 5.78 |
| 6 | 317744 | 480138 | No Data | No Data | No Data | No Data | No Data | 6.91 | 5.79 |
| 7 | 317769 | 480138 | No Data | No Data | No Data | No Data | No Data | 6.91 | 5.79 |
| 8 | 317794 | 480138 | No Data | No Data | No Data | No Data | No Data | 6.90 | No Data |
| 16 | 317744 | 480188 | No Data | No Data | No Data | No Data | No Data | 6.93 | 5.79 |

**Table 8 - Environment Agency Undefended Modelled Tidal Water Depths (m)**

| Node Reference | Eastings | Northings | Return Period (yrs) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 20 | 50 | 75 | 100 | 200 | 200 (+600mm Climate Change) | 1000 |
| 1 | 317744 | 480113 | No Data | No Data | No Data | No Data | No Data | 1.32 | 0.20 |
| 6 | 317744 | 480138 | No Data | No Data | No Data | No Data | No Data | 1.47 | 0.35 |
| 7 | 317769 | 480138 | No Data | No Data | No Data | No Data | No Data | 1.23 | 0.11 |
| 8 | 317794 | 480138 | No Data | No Data | No Data | No Data | No Data | 1.05 | No Data |
| 16 | 317744 | 480188 | No Data | No Data | No Data | No Data | No Data | 1.65 | 0.51 |

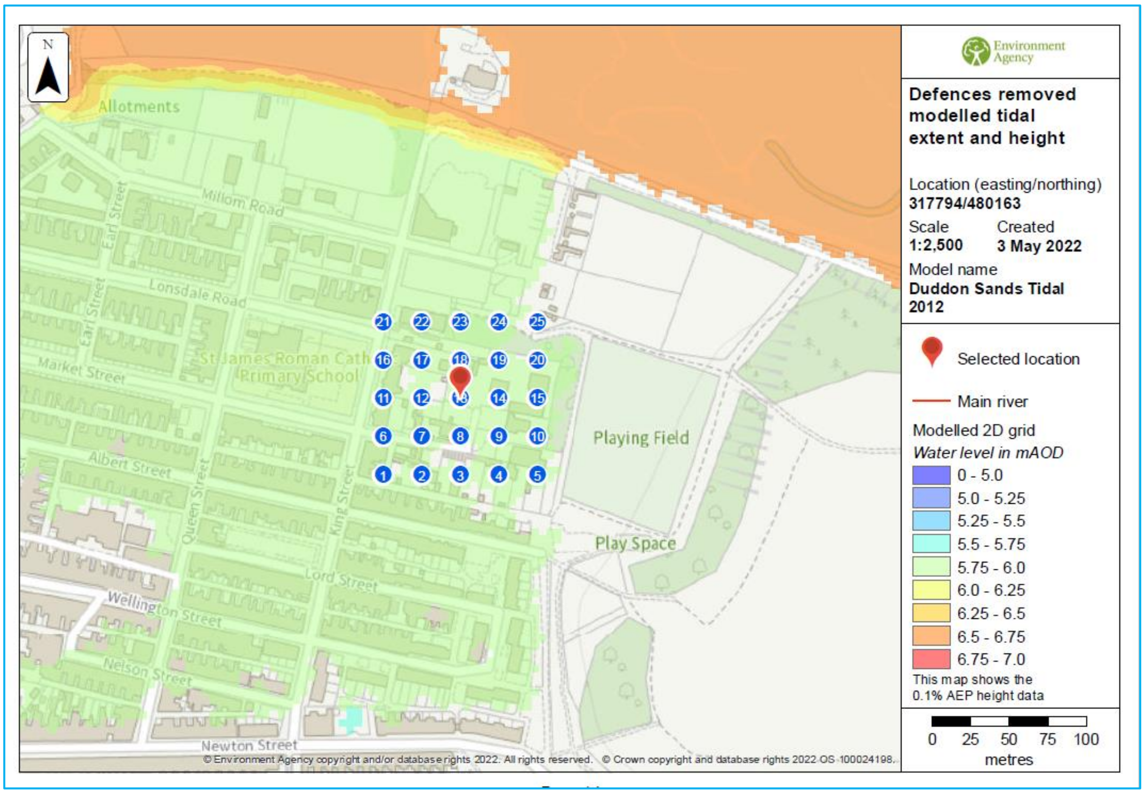



**Figure 5 - Environment Agency Undefended Modelled 1 in 1000 Year Flood Outline**

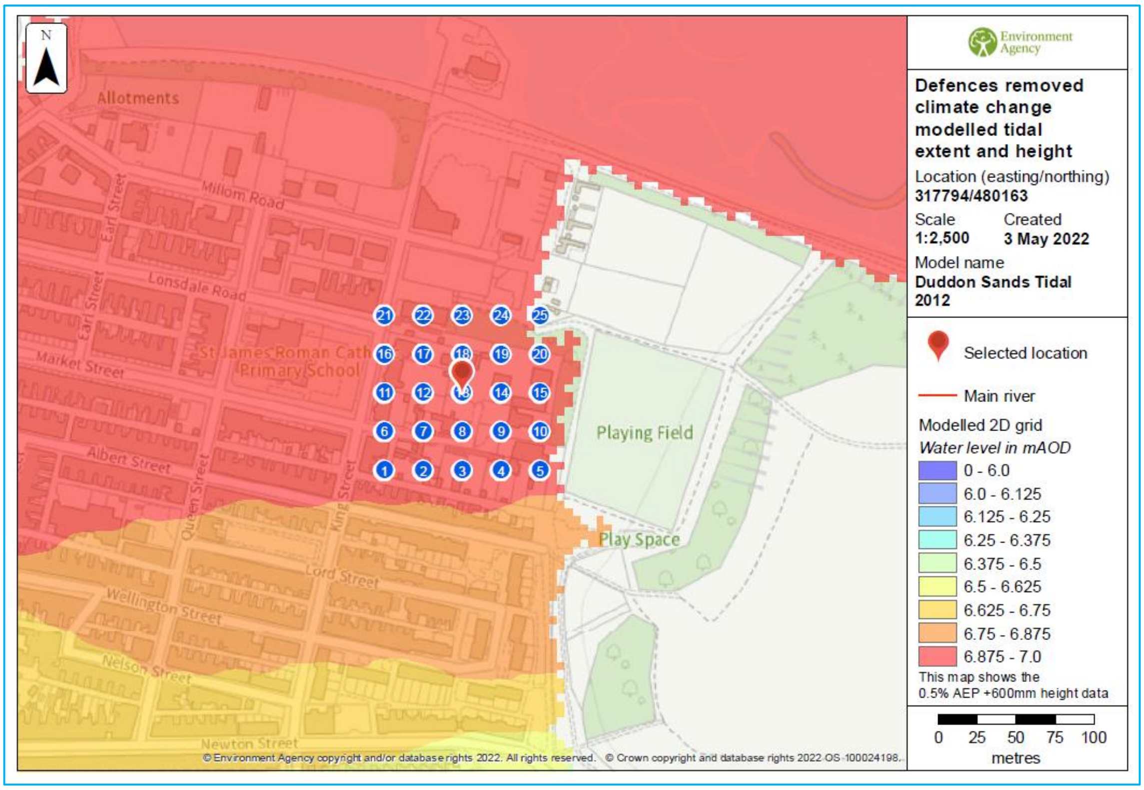



**Figure 6 - Environment Agency Undefended 1 in 200 Year (plus climate change) Flood Outline**

The mechanism for tidal flooding is generally prolonged episodes of high sea levels, which affords good time for flood warnings to be issued. The likelihood of a rapid water level rise and possible rapid inundation of urban areas posing a risk to life is considered to be minimal with a forewarning of two (2) days of a pending flood event.

The site is located within a low risk area where the onset of flooding is very gradual (many hours) as per Flood Risk Assessment Guidance for New Development Phase 2, R&D Technical Report FD2320/TR2. Given the scale and nature of the proposed development and the size and location of the tidal flooding sources it has been concluded that tidal flooding poses a low flood risk to the site.

The actual flood risk posed to the site is less than the 1 in 1000 year event and the residual flood risk posed to the site is low and is less than 1 in 200 years. It can be concluded that tidal flooding from tidal flooding poses a low actual and residual risk to the site. Therefore, the risk of flooding from tidal flooding is considered to be of **medium significance**. The risk from tidal flooding will be further mitigated by using a number of property level protection measures to manage and reduce the overall flood risk at the site (see Section 5.0).

### 3.10 Groundwater Flooding

Groundwater flooding is defined as the emergence of groundwater at the ground surface or the rising of groundwater into man-made ground under conditions where the normal range of groundwater levels is exceeded.

Groundwater flooding tends to occur sporadically in both location and time. When groundwater flooding does occur, it tends to mostly affect low-lying areas, below surface infrastructure and buildings (for example, tunnels, basements and car parks) underlain by permeable rocks (aquifers).

The risk of flooding from groundwater flooding is considered to be **not significant**. The risk from this source will be further mitigated by using a number of property level protection measures to manage and reduce the overall flood risk at the site (see Section 5.0).

### 3.11 Surface Water (pluvial) Flooding

Surface water flooding tends to occur sporadically in both location and time such surface water would tend to be confined to the streets around the development. The site is not situated near to large areas of poor permeability.

The Environment Agency Surface Water flood map shows that the site has a very low of surface water flooding (see Figure 7) with a chance of flooding of less than 1 in 1000 (0.1%) years. The risk of flooding from surface water flooding is considered to be of **low significance**. The risk from this source will be further mitigated by using a number of property level protection measures to manage and reduce the overall flood risk at the site (see Section 5.0).

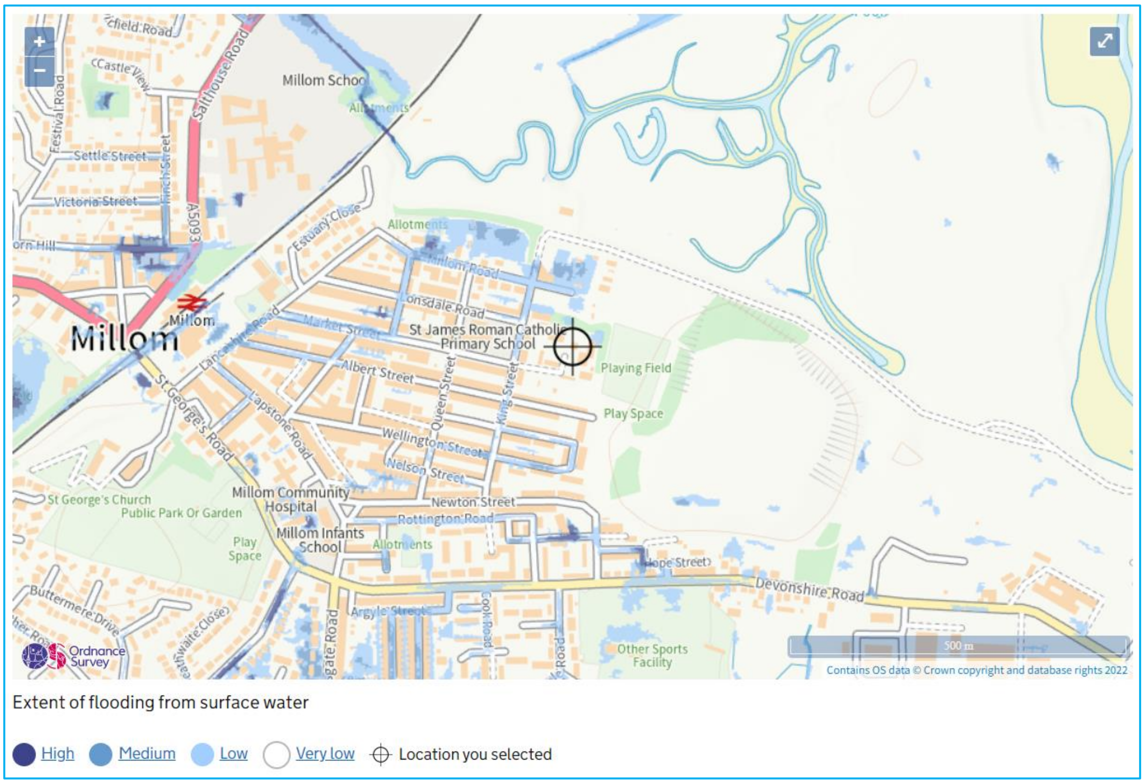



**Figure 7 - Environment Agency Surface Water Flood Risk Map**

## 3.12 Sewer Flooding

Sewer flooding occurs when urban drainage networks become overwhelmed and maximum capacity is reached. This can occur if there is a blockage in the network causing water to back up behind it or if the sheer volume of water draining into the system is too great to be handled. Sewer flooding tends to occur sporadically in both location and time such flood flows would tend to be confined to the streets around the development.

There are existing sewers located within the vicinity of the site and these will inevitably have a limited capacity so in extreme conditions there would be surcharges, which may in turn cause flooding. Flood flows could also be generated by burst water mains but these would tend to be of a restricted and much lower volume than weather generated events and so can be discounted for the purposes of this assessment.

Given the design parameters normally used for drainage design in recent times and allowing for some deterioration in the performance of the installed systems, which are likely to have been in place for many years, an appropriate flood risk probability from this source could be assumed to have a return period in the order of 1 in 10 to 1 in 20 years. The provision of adequate level difference between the ground floors and adjacent ground level would reduce the annual probability of damage to property from this source to 1 in 100 years or less.

There are no reported incidents of sewer flooding within the vicinity of the site therefore, sewer flooding poses a flood risk to the site. Therefore, the risk of flooding from sewer flooding is considered to be of **low significance**. The risk from this source will be further mitigated by using a number of property level protection measures to manage and reduce the overall flood risk at the site (see Section 5.0).

### 3.13 Flooding from Artificial Drainage Systems/Infrastructure Failure

There are no other nearby artificial water bodies, reservoirs, water channels and artificial drainage systems that could be considered a flood risk to the site. Figure 8 shows that the site is not at risk of flooding from reservoir failure. The risk of flooding from artificial drainage systems/infrastructure failure is considered to be **not significant**.

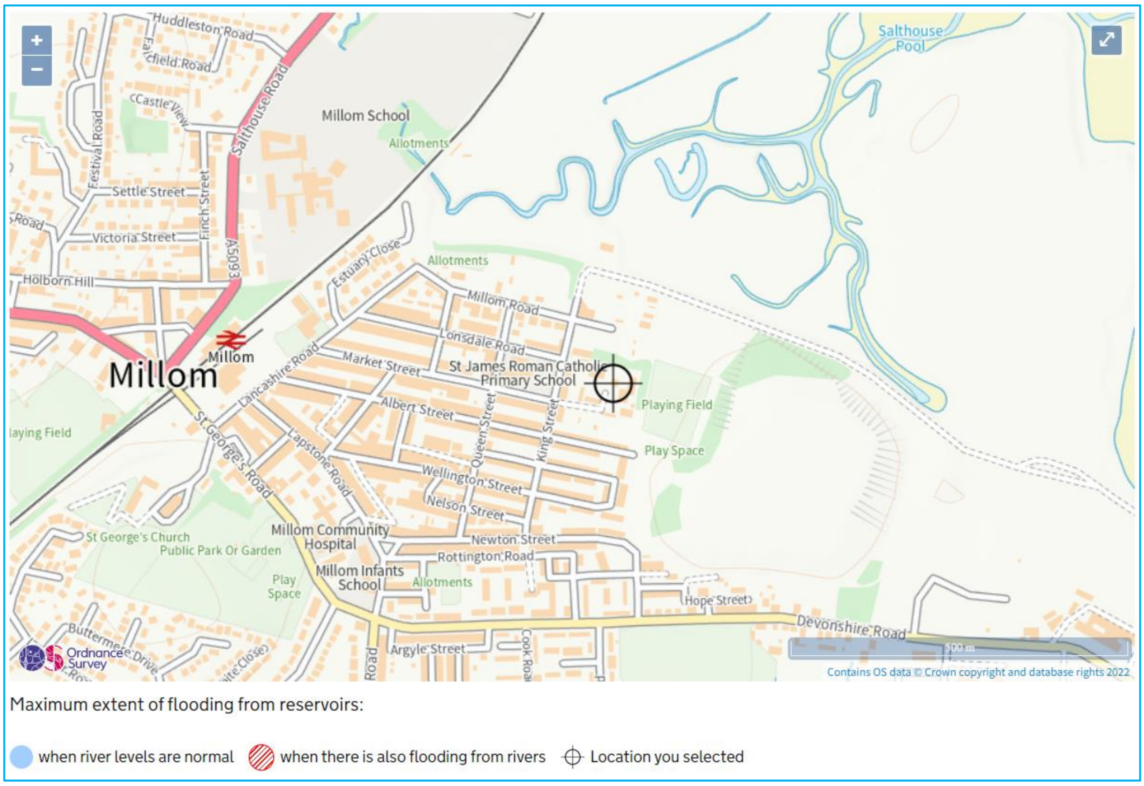



**Figure 8 - Environment Agency Reservoir Flood Risk Map**

### 3.14 Effect of the Development on Flood Risk

Based on the available information, the site is currently protected by tidal flood defences. There is therefore currently no presence of flood flow routes or floodplain storage on site. The proposed development would therefore not result in any impedance of flood flows or displacement of existing floodplain with the existing flood defences to be maintained and improved in the future to further ensure the development is not within an area susceptible to flood flows and floodplain in normal operation.

In the context of a catastrophic failure of existing defences, the built area associated with the development would have no material adverse impact on flood flow routes or floodplain displacement in any case given the significant flooding which would be present in the immediate area in this breach scenario.

The proposed development will have no impact on the movement of floodwater across the site. The overall direction of the movement of water will be maintained within the developed site and surrounding area. The conveyance routes (flow paths) will not be blocked or obstructed. There will be no increase in the floodwater levels due to the proposed development. There will be no loss in flood storage capacity and no change in the on-site and off-site flood risk.

### 3.15 Summary Site Specific Flood Risk Assessment

A summary of the sources of flooding and a review of the risk posed by each source at the site is shown in Table 9.

**Table 9 - Risk Posed by Flooding Sources**

| Sources of Flooding | Potential Flood Risk | Potential Source | Probability/Significance |
|---|---|---|---|
| Fluvial Flooding | No | None Reported | None |
| Tidal Flooding | Yes | Duddon Sands/Channel | Medium |
| Groundwater Flooding | No | None Reported | None |
| Surface Water Flooding | Yes | Poor Permeability | Low |
| Sewer Flooding | Yes | Local Sewers | Low |
| Flooding from Artificial Drainage Systems/Infrastructure Failure | No | None Reported | None |

The site is unlikely to flood except in extreme conditions, the primary, but unlikely, flood risk posed to the site is from tidal flooding. The site is located within Flood Zone 2 and therefore has a 'medium probability' of flooding. Flood Zone 2 has between a 1 in 100 and 1 in 1000 annual probability of flooding (1% - 0.1%) in any year.

*Defended Scenario*

Considerable investment has been made in the provision of the flood defences to protect the area from tidal flooding. The site is currently protected against tidal flooding. The site will be flood free up to the defended 1 in 1000 year event. The actual flood risk posed to the site is low and is less than 1 in 1000 years therefore, the tidal flood risk posed to the site can be considered a residual risk. The actual flood risk posed to the site is low and is less than 1 in 1000 years. During the defended 1 in 200 year (plus climate change) event therefore, the site may be inundated with floodwater to a maximum depth of 0.28m.

Undefended Scenario

The flood defences can only protect up to a point, they may malfunction, can be breached and have a finite structure life. Therefore, there is a residual risk of tidal flooding. If the flood defences were not there, the area would be flooded. However, as area of land may benefit from the presence of flood defences even if the flood defences are overtopped, the presence of the flood defences means that the floodwater does not extend as far as it would if the flood defences were not there. It is unlikely

The site will not be inundated with floodwater for all events up to and including the undefended 1 in 200 year event. The site will be flood free during the undefended 1 in 200 year event, the residual flood risk posed to the site is low and is less than 1 in 200 years.

During the undefended 1 in 200 year (plus climate change) event, the site may be inundated with floodwater to a maximum depth of 1.65m and during the undefended 1 in 1000 year event a maximum depth of 0.51m would be experienced.

The actual flood risk posed to the site is less than the 1 in 1000 year event and the residual flood risk posed to the site is low and is less than 1 in 200 years. It can be concluded that tidal flooding from tidal flooding poses a low actual and residual risk to the site. Therefore, the risk of flooding from tidal flooding is considered to be of **medium significance**. A number of secondary flooding sources have been identified which may pose a **low significant** risk to the site. These are:

- Surface Water Flooding
- Sewer Flooding

The application is for a new, suitable flood-resilient design. The exposure of people and property will be reduced and minimised compared to existing site conditions. The chance of flooding each year is low each year. This takes into account the effect of any flood defences that may be located within the vicinity of the site as well property level protection measures.

# 4.0 SURFACE WATER DRAINAGE

## 4.1 Surface Water Management Overview

It is recognised that consideration of flood issues should not be confined to the floodplain. The alteration of natural surface water flow patterns through developments can lead to problems elsewhere in the catchment, particularly flooding downstream. For example, replacing vegetated areas with roofs, roads and other paved areas can increase both the total and the peak flow of surface water runoff from the site. Changes of land use on previously developed land can also have significant downstream impacts where the existing drainage system may not have sufficient capacity for the additional drainage.

A SuDS Strategy for the proposed development has been prepared to manage and reduce the flood risk posed by the surface water runoff from the site. The requirement for managing surface water runoff from developments depends on the predeveloped nature of a site. The surface water drainage arrangements for any development location should be such that the volumes and peak flow rates of surface water leaving a developed site are no greater than the rates prior to the development unless specific offsite arrangements are made and result in the same net effect.

It should be acknowledged that the satisfactory collection, control and discharge of surface water runoff are now a principle planning and design consideration. This is reflected in recently implemented guidance as well as the Defra non-statutory technical standards for SuDS.

## 4.2 Climate Change

Projections of future climate change in the UK indicate more frequent, short-duration, high intensity rainfall and more frequent periods of long duration rainfall. Guidance included within the NPPF recommends that the effects of climate change are incorporated into FRAs. Recommended precautionary sensitivity ranges for peak rainfall intensities are outlined in the Flood risk assessments: climate change allowances guidance[7].

The recommended national precautionary sensitivity range for peak rainfall intensity are summarised in Table 10.

**Table 10 - Peak Rainfall Intensity Allowance in Small and Urban Catchment (use 1961 to 1990 baseline)**

| Return Period (yrs) | Parameter | 2050s | 2070s |
|---|---|---|---|
| 30 | Upper end | +40% | +45% |
| | Central | +25% | +35% |
| 100 | Upper end | +45% | +50% |
| | Central | +30% | +35% |

## 4.3 Greenfield Runoff Rates

An estimation of surface water runoff is required to permit effective surface water management and prevent any increase in flood risk to off-site receptors. In accordance with The SuDS Manual, the greenfield runoff rate from the site has been calculated using the IoH124 method. Table 11 shows the IoH 124 method Greenfield runoff rates for the proposed impermeable area of 0.020 hectares (h)a

[7] https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#high-allowances

(see Appendix 3). QBAR has been calculated to be 0.16 litres/second (l/s). The method used for calculating the runoff complies with the NPPF, as well as the Defra non-statutory technical standards for SuDS.

**Table 11 - IoH124 Method Greenfield Runoff Rates**

| Rainfall Event | Runoff Rate (l/s) |
|---|---|
| 1 | 0.14 |
| QBAR (rural) | 0.16 |
| 30 | 0.27 |
| 100 | 0.33 |

### 4.4 Opportunities for Discharge of Surface Water

There are three possible options to discharge the surface water runoff in accordance with requirements of the Building Regulations; a hierarchy that is also promoted within the NPPF. Rainwater shall discharge to one of the following, listed in order of priority:

- an adequate soakaway or some other adequate infiltration system; or, where that is not reasonably practicable,
- a watercourse; or where that is not reasonably practicable,
- a sewer.

It is necessary to identify the most appropriate method of controlling and discharging surface water.

### 4.5 Soakaway / Infiltration System

An overview of the general ground conditions may be used to gauge if there is potential for their application. Due to the site ground conditions, large scale infiltration devices may not be suitable for the discharge of surface water. If an infiltration system is proposed, it is recommended that a series of infiltration/soakaway tests are carried out on site to BRE Digest 365 Guidelines to confirm the assumptions made in the calculations. Such work is beyond the scope of this FRA.

### 4.6 Watercourse

Should infiltration be found to be unsuitable, the next option is discharge to a watercourse. There are no watercourses, on or, within the vicinity of the site. No formal drainage features are identified within the existing site boundary or within the vicinity of the site. Consequently, it would not be possible to discharge surface water runoff from the site into a watercourse.

### 4.7 Sewer

In the event that discharge of surface water via infiltration or discharge to a watercourse is deemed unsuitable, then discharge to the public sewer would be possible within the vicinity of the site. Surface water discharge to the public sewers would be restricted and attenuated on site before discharge to the public sewers.

### 4.8 SuDS and Water Quality

A key requirement of any SuDS system is that it protects the receiving water body from the risk of pollution, and this is particularly true for surface water courses. This can be effectively managed by an appropriate “train” or sequence of SuDS components that are connected in series. The frequent and short duration rainfall events or the initial phase of longer duration events are those that are mostly loaded with potential contaminants (silts, fines, heavy metals and various organic and inorganic contaminants). Therefore, the first 5-10mm of rainfall (first flush) should be adequately treated with SuDS that are most effective in removing these potential contaminants (infiltration to the ground, filtration through a parking area sub-base, detention and sedimentation through storage in ponds and swales).

Proposed SuDS must account for a sufficient number of treatment stages to protect the receiving waterbody. The minimum number of treatment stages will depend on the sensitivity of the receiving waterbody and the potential hazard associated with the proposed development. Current guidance promotes sustainable water management through the use of SuDS. SuDS measures should be used to control the surface water runoff from the proposed development site therefore, managing the flood risk to the site and surrounding areas from surface water runoff.

One of the aims of the NPPF is to provide not only flood risk mitigation but also to maximise additional gains such as improvements in runoff quality and provision of amenity and bio-diversity. Systems incorporating these features are often termed SuDS and it is the requirement of NPPF that these are considered as the primary means of collection, control and disposal for storm water as close to source as possible.

A hierarchy of techniques is identified[8]:

1. **Prevention** – the use of good site design and housekeeping measures on individual sites to prevent runoff and pollution (e.g. minimise areas of hard standing).

2. **Source Control** – control of runoff at or very near its source (such as the use of rainwater harvesting, permeable paving, soakaways and/or green roofs).

3. **Site Control** – management of water from several sub-catchments (including routing water from roofs and car parks to one/several large soakaways for the whole site, swales and/or infiltration trenches).

4. **Regional Control** – management of runoff from several sites, typically in a detention pond, basins, tanks and/or wetland.

It is generally accepted that the implementation of SuDS as opposed to conventional drainage systems, provides several benefits by:

- reducing peak flows to watercourses or sewers and potentially reducing the risk of flooding downstream;
- reducing the volumes and frequency of water flowing directly to watercourses or sewers from developed sites;
- improving water quality over conventional surface water sewers by removing pollutants from diffuse pollutant sources;
- reducing potable water demand through rainwater harvesting;
- improving amenity through the provision of public open spaces and wildlife habitat; and
- replicating natural drainage patterns, including the recharge of groundwater so that base flows are maintained.

[8] CIRIA (2004) Report C609, Sustainable Drainage Systems – Hydraulic, Structural and Water Quality advice.

The SuDS Manual and Environment Agency guidance applies a sustainability hierarchy to the various types of SuDS systems, this is summarised in Table 12. Systems at the top of the hierarchy provide a combination of attenuation, treatment and ecology and are deemed the most sustainable options. There are always specific scenarios where systems are more suitable than others and at this stage it is not possible to guide the development towards a particular strategy.

The usual approach is to consider the 'SuDS train' where each of the above options are considered in turn until a suitable solution is found. Thus, source control techniques such as soakaways, rainwater harvesting and/or infiltration trenches, if suitable on a site, are considered preferable to permeable conveyance and passive treatment systems such as tanks or ponds.

The most appropriate attenuation system will need to satisfy three main characteristics, firstly, provide the required volume of storage, secondly, minimise the loss of developable land and thirdly, where possible provide local amenity.

The application of the SuDS Manual requires that the runoff from sites is not only restricted to meet the Greenfield runoff characteristics but also that SuDS systems are utilised to improve the quality of the runoff prior to outfall from the site. The various options for the site are considered in outlined in Table 13.

**Table 12 - Sustainability Hierarchy**

| Most Sustainable | SuDS Technique | Flood Reduction | Pollution Reduction | Landscape & Wildlife |
|---|---|---|---|---|
| | **Rainwater Harvesting** | ✓ | ✓ | ✓ |
| | **Green / Living Roofs** | ✓ | ✓ | ✓ |
| | **Basins and Ponds**<br>- Constructed wetlands<br>- Balancing ponds<br>- Detention basins<br>- Retention ponds | ✓ | ✓ | ✓ |
| | **Filter Strips and Swales** | ✓ | ✓ | ✓ |
| | **Infiltration Devices**<br>- Soakaways | ✓ | ✓ | ✓ |
| | **Permeable Surfaces and Filter Drains**<br>- Gravelled areas<br>- Solid paving blocks<br>- Permeable paving | ✓ | ✓ | |
| Least Sustainable | **Tanked Systems**<br>- Over-sized pipes / tanks<br>- Cellular storage | ✓ | | |

**Table 13 - SuDS Techniques**

| SuDS Technique | Comments | Suitability for Development |
|---|---|---|
| Green / Living Roofs / Living Wall | Can be used on low rise buildings to provide retention, attenuation and treatment of rainwater, and promotes evaporation and local biodiversity. | Not a practical option for the proposed development. A green/living roof/living wall would not provide all of the attenuation storage requirements alone. |
| Basins / Ponds | Provides storage of runoff and flow attenuation. Vegetated surfaces can be used to support the prevention of runoff from the site for small rainfall events (interception) and improve water quality associated with the removal of sediment and buoyant materials. | Not the required area available, especially given the side slopes need to be 1 in 4 max. Without the space the volume attenuated would be very small to be virtually insignificant. |
| Filter Strips / Swales | Good removal of urban pollutants, reduces runoff rates and volumes. | Potential to be used on the site. |
| Infiltration Devices (e.g. soakaways, permeable paving) | Reduces total runoff volume from the development. | Due to the site ground conditions, large scale infiltration devices may not be suitable for the discharge of surface water. |
| Permeable Surfaces and Filter Drains | Permeable surfaces together with their associated substructures are an efficient means of intercepting runoff, reducing the volume and frequency of runoff and providing a treatment medium. | Can be used as a conveyance feature and to provide water quality benefits on the site. |
| Tanked Systems | Ideal for sites with insufficient space for basins etc., provide a volume of below ground storage with a high void ratio. | Potential to be installed under the site. |
| Water Butts / Rainwater Harvesting | Can provide non-potable water for re-use on site. | Will not provide the required attenuation storage requirements b due to the low demand of the site, may be used to provide betterment |
| Bioretention Areas / Tree Pits | Can be used to provide small scale infiltration/evaporation of water as well as water quality, amenity and biodiversity benefits. | Can be used as a conveyance features and to provide water quality benefits on the site but not as a primary means of infiltration. |
| Flow Reduction | Manages and reduces the flood risk to the local surface water sewers and watercourses. | A hydrobrake can be installed downstream of attenuation tanks and control flows to the natural Greenfield runoff rates. |

### 4.9 Proposed SuDS Strategy

The objective of this SuDS Strategy is to ensure that a sustainable drainage solution can be achieved which reduces the peak discharge rate to manage and reduce the flood risk posed by the surface water runoff from the site. The SuDS Strategy takes into account the following principles:

- No increase in the volume or runoff rate of surface water runoff from the site.
- No increase in flooding to people or property off-site as a result of the development.
- No surface water flooding of the site.
- The proposals take into account a 40% increase in rainfall intensity due to climate change during the next 100 years which is the lifetime of the development.

In line with adopting a 'management train' it is recommended that water is managed as close to source as possible. This will reduce the size and cost of infrastructure further downstream and also shares the maintenance burden more equitably. It is therefore recommended that the site provides its own attenuation. This will be in the form of:

- Any areas of hardstanding areas (car parks, driveways etc.) within the development shall be constructed of a permeable surface including:
    - Using gravel or a mainly green, vegetated area.
    - Directing water from an impermeable surface to a border rain garden or soakaway.
    - Using permeable block paving, porous asphalt/concrete.
- Water butts/rainwater harvesting.
- Bioretention Areas/Tree Pits
- Underground attenuation storage.
- Discharge to the public sewers at a restricted runoff rate.

For all development, both the Building Regulations and NPPF promote a hierarchical approach to surface water management. This approach has been adopted within this SuDS Strategy, infiltration is not possible and there are no watercourses located within the vicinity of the site therefore, discharge will be to the public sewers at a restricted runoff rate.

QBAR has been calculated to be 0.16l/s however, it is not possible to reduce surface water runoff to below 2.00l/s due to practical pipe sizes etc. Therefore, the surface water runoff from the site will be restricted to 2.00l/s before discharge to the public sewers after attenuation on the site.

As a consequence of limiting the rate of discharge from the site, at times of heavy rainfall the volume of water leaving the site will be significantly less than that draining from it. In order to prevent this water backing up in the system and causing flooding attenuation storage has been provided within the manholes and pipes within the system. The size of the attenuation storage has been calculated such that the proposed development has the capacity to accommodate the 1 in 100 year rainfall event including a 40% increase in rainfall intensity that is predicted to occur as a result of climate change. Consequently, all areas drained have been designed to accommodate a 100 year (+40% climate change) storm event. A storage volume of 4.50 to 9.00$m^3$ will be required (see Appendix 3).

Flooding will not occur on any part of the site during the 1 in 30 year event, no flooding will occur within any part of the buildings during the 1 in 100 year (+40%) event, all areas drained have been designed to accommodate the 1 in 100 year (+40%) event.

Surface water runoff would be directed to the drainage system through drainage gullies located around the perimeter of the buildings and through contouring of the hardstanding areas. These methods will reduce peak flows, the volume of runoff, and slow down flows and will provide a suitable SuDS solution for this site.

The adoption of a SuDS Strategy for the site represents an enhancement from the current conditions as the current surface water runoff from the site is uncontrolled, untreated, unmanaged and unmitigated. In adopting these principles, it has been demonstrated that a scheme can be developed that does not increase the risk of flooding to adjacent properties and development further downstream.

### 4.10 Designing for Local Drainage System Failure/Design Exceedance

When considering residual risk, it is necessary to make predictions as to the impacts of a storm event that exceeds the design event, or the impact of a failure of the local drainage system. The SuDS Strategy applies a safe and sustainable approach to discharging rainfall runoff from the site and this reduces the risk of flooding however, it is not possible to completely remove the risk. This section of the FRA is therefore associated with the way the residual risk is managed.

As part of the SuDS Strategy it must be demonstrated that the flooding of property would not occur in the event of local drainage system failure and/or design exceedance. It is not economically viable or sustainable to build a drainage system that can accommodate the most extreme events. Consequently, the capacity of the drainage system may be exceeded on rare occasions, with excess water flowing above ground[9].

The SuDS Strategy has been designed to accommodate the 1 in 100 year storm event plus climate change (+40%). The design of the site layout provides an opportunity to manage this local drainage system failure/exceedance flow and ensure that indiscriminate flooding of property does not occur.

There will not be an extensive sewerage network on the proposed development site and therefore any potential exceedance flooding would be from the sewers and lateral drains connecting the properties to the infiltration devices. It is very unlikely that a catastrophic failure would occur. An exceedance or blockage event of the drains would not affect the proposed buildings because the finished floor level will be raised above surrounding ground levels, ensuring any exceedance flooding would not affect the buildings. It is not considered that there is an increased risk to the properties on the site or located adjacent to the site.

In particular, the landscaped areas will include preferential flow paths that convey water away from building. Surface water runoff would be directed to the drainage system through drainage gullies located around the perimeter of the buildings and through contouring of the hardstanding areas.

When considering the impacts of a storm event that exceeds the 1 in 100 year (+40%) event, there is safety, even under the design event conditions. Consequently, if this event were to be exceeded there is additional capacity with the system to accommodate this (i.e. the manholes, pipework etc.). If this freeboard was to be exceeded the consequences would be similar, if not less than for the local drainage system failure.

[9] CIRIA (2006) Designing for exceedance in urban drainage – good practice.

The ground levels will slightly slope away from the buildings which will result in exceedance flows away from the buildings into the drainage network and if required the landscaped areas on the boundary of the site. Furthermore, the finished floor levels of the buildings will be raised above the external ground levels. Consequently, the impact of an exceedance event is not considered to represent any significant flood hazard.

The above manages and mitigates the flood risk from surface water runoff to the proposed properties from surface water runoff generated by the site development and to offsite locations as well the risk from surface water runoff generated offsite.

# 5.0 RISK MANAGEMENT

## 5.1 Introduction

The flood risk at this location is considered suitable for 'more vulnerable' developments within the NPPF. In this flood zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area through the layout and form of the development and the use of flood mitigation measures.

A number of techniques and mitigation strategies to manage and reduce the overall flood risk in the area will be used. This will ensure the development will be safe and there is:

- Minimal risk to life;
- Minimal disruption to people living and working in the area;
- Minimal potential damage to property;
- Minimal impact of the proposed development on flood risk generally; and;
- Minimal disruption to natural heritage.

The flood risk at the site will be reduced by property level protection measures, these are discussed in more detail below.

## 5.2 Finished Floor Level

The proposed finished floor levels will be set at 150mm above the external ground level at the location of the proposed house at approximately 5.44mAOD. It is recognised however, that owing to limited headroom constraints, massing, planning policy and Building Regulations, it is considered impractical to raise the finished floor levels further. A combination of resistance (proofing) and resilience measures will be included to further provide protection. This is discussed below.

## 5.3 First Floor Accommodation

Accommodation will be located on the first floor as well as the ground floor of the house. This will allow occupants to retreat to higher floor levels if needed. The levels of the first floor are located well above any floodwater levels

This provides a 'safe haven' above any floodwater levels. This will enable rapid escape should flooding occur which is unlikely. The upper floors are accessed via internal stairs and are sufficient in size to safely house all occupants of the building. The 'safe haven' will only be required in very extreme events or if a flood warning has not been received.

## 5.4 Flood Resilience and Resistance

The development of the layout should always consider that the site is potentially at risk from an extreme event and as such the implementation of flood resilience and resistance methods should be assessed.

To make the building more resistant to seepage the following measures will be incorporated. Sealant will be used around external doors and windows. All external doors and windows will be constructed from durable materials and the walls of the building will be thick.

To improve the buildings resilience to flooding the following measures will be incorporated. All electrical wiring, switches, sockets, socket outlets, electrical, and gas meters etc. will be located a minimum of 450mm above the finished floor level.

### 5.5 Flood Plan

A Flood Plan outlining the precautions and actions you should take when a flood event is anticipated to help reduce the impact and damage flooding may cause will be developed. Sensible precautions would include raising electrical items, irreplaceable items and sentimental items off the ground or where possible moving them to a higher floor, rolling up carpets and rugs and turning off utilities. In addition, consider what actions you would take should the property need to be evacuated including access and egress routes and preparing a flood kit in advance containing warm clothing, medication, a torch, food and wellingtons.

The Flood Plan is a 'living' document and therefore should be periodically reviewed and updated to provide advice and guidance to occupants in the event of an extreme flood. The Flood Plan will therefore reduce the vulnerability of the occupants to flooding and makes them aware of the mechanisms of flooding at the property.

### 5.6 Access and Egress Route

The NPPF requires that, where required, safe access and escape is available to/from new developments in flood risk areas. Access routes should be such that occupants can safely access and exit their dwellings in design flood conditions. These routes must also provide the emergency services with access to the development during a flood event and enable flood defence authorities to carry out any necessary duties during the period of flood.

The Planning Practice Guidance to the NPPF confirms that *'Access and egress must be designed to be functional for changing circumstances over the lifetime of the development. Specifically:*

- *Access routes should allow occupants to safely access and exit their dwellings in <u>design flood conditions</u>. Vehicular access to allow the emergency services to safely reach the development during design flood conditions will also normally be required.*

- *Wherever possible, safe access routes should be provided that are located above design flood levels and avoiding flow paths. Where this is not possible, limited depths of flooding may be acceptable, provided that the proposed access is designed with appropriate signage etc to make it safe. The acceptable flood depth for safe access will vary depending on flood velocities and the risk of debris within the flood water. Even low levels of flooding can pose a risk to people in situ (because of, for example, the presence of unseen hazards and contaminants in floodwater, or the risk that people remaining may require medical attention)'.*

A safe access and egress route, including emergency access can be maintained for vehicles and/or by foot. The site is at such a ground level that it would only flood in the most extreme flood event. Likewise, the access and egress route will remain dry in all but these most extreme scenarios. A safe access and egress route with minimum water depths would be possible for many hours if not days. This would provide more than an adequate amount of time for the site to be evacuated, if required.

The flood defence measures identified are expected to afford the site significant protection from tidal flooding. The site will be flood free during the defended 1 in 1000 year event. The actual flood risk posed to the site is low and is less than 1 in 1000 years. During the defended 1 in 200 year (plus climate change) event therefore, the site may be inundated with floodwater to a maximum depth of 0.28m and on the site access to a maximum depth 0.14m. Therefore, a safe access and egress route can be maintained for all events up to and including the defended 1 in 200 year (plus climate change) event in accordance with the NPPF and Environment Agency guidance.

The Safe Access and Egress Route shown in Figure 9 indicates the exit routes that all people (i.e. occupants and visitors) on site should follow once a flood warning has been received. People should make their way to areas outside of the flood zone.

In the event of a Flood Warning, vital belongings, including waterproof clothing, necessary medication and essentials for infants and children will be collected. It should be ensured that all occupiers and visitors to the site are accounted for, and then exit the site.

Facilities such as community centres, shops etc. are located to the north of the site which may be used in the event of a flood event. There may also be large areas than those shown in Figure 2 that are flood free located nearer and within the vicinity of the site. In the event of a Flood Warning, vital belongings, including waterproof clothing, necessary medication and essentials for infants and children will be collected. It should be ensured that all occupiers and visitors to the site are accounted for, and then exit the site using the route shown in Figure 9.

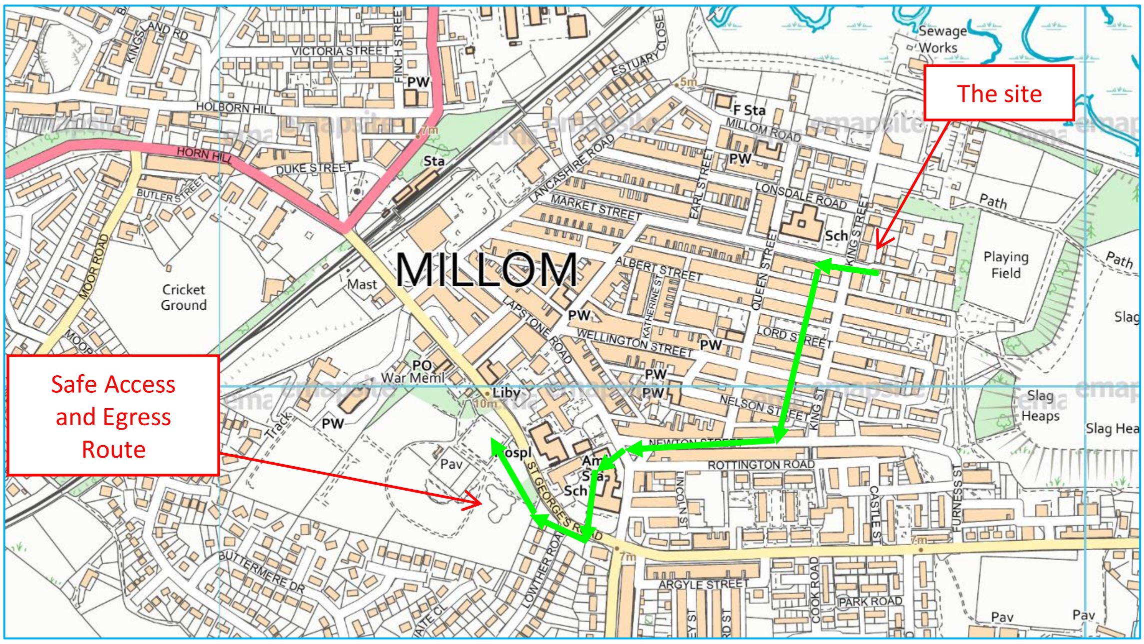



**Figure 9 - Safe Access and Egress Route**

## 5.7 Residual Risk

The mitigation measures detailed above show that the flood risk can be effectively managed and therefore the consequences of flooding are acceptable. The site is unlikely to flood except in extreme conditions. This takes into account the property level protection measures.

# 6.0 SEQUENTIAL APPROACH

## 6.1 Sequential Test

The risk-based Sequential Test in accordance with the NPPF aims to steer new development to areas at the lowest probability of flooding (i.e. Flood Zone 1). However, where an individual proposes to develop a site in an existing flood risk area the consideration of alternative sites is not likely to be a realistic option.

The site is located in Flood Zone 2 and therefore has a 'medium probability' of flooding. Flood Zone 2 has between a 1 in 100 and 1 in 1000 annual probability of flooding (1% - 0.1%) in any year. The flood defence measures identified are expected to afford the site significant protection from tidal flooding. The site falls outside the breach flood outlines the site is considered to have a low residual risk of tidal flooding. It can be concluded that tidal flooding poses a low actual and residual risk to the site.

It is impractical to suggest that there are more suitable locations for this development elsewhere. This is the only site in the ownership of the client and therefore the only site available to them to develop. The cost of buying a similar site and the cost to construct a similar development would make it uneconomical. This is the only site in the ownership of the client and therefore the only site available to them to develop. The site proposals cannot be located in another site elsewhere. There are no alternative sites available to develop with a comparable size for residential uses within this area.

No 'reasonably available' alternative sites have been identified within the sites identified for residential uses within this area. The sites are already developed and are not available to construct the site proposals.

The Council's objectives are to sustain and enhance the vitality and viability of the region, and to ensure a wide range of businesses to which people have easy access by a range of transport therefore, improving the overall quality of life. This is underpinned by the quality of the physical environment, social well-being and economic and environmental improvements. The Council seeks to grant permission for developments that add to the vitality and viability of the region.

This site will help to regenerate the region and will help to deliver these objectives. This site will help encourage economic impetus that will in turn help deliver a stronger service function and mix of housing uses.

The site proposals remain consistent with the relevant planning policies and are not at odds with the current use of the site and can only enhance and preserve the residential base which currently exists. The wider area surrounding the proposed development site is affected by a very similar, and in many cases, higher risk of flooding. The application is for a new, suitable flood-resilient design. The exposure of people and property will be minimised.

Flood risk at the site will be further mitigated by using a number of property level protection measures to manage and reduce the overall flood risk at the site. The proposed development will improve the sites resilience, resistance to flooding and by using property level protection measures to protect the site from flooding the vulnerability of the site will be improved (see Section 5.0).

Incidentally, the level of identified need for houses means that it is not a simple case of development on this site or on an alternative site. The Council continues to assess potential sites, in addition to this site. Whilst flood risk is a significant material planning consideration and the LPA will continue to seek to minimise flood risk and identify development sites at the lowest risk of flooding - suitable, available and viable sites for housing is scarce. Those sites that meet the criteria, subject to gaining planning permission, need to be brought forward to help meet the identified need.

Similar buildings on any site outside a Flood Zone will not offer any advantage vis-a-vis flooding. Consequently, application of the Sequential Test demonstrates that there is no measurable advantage to constructing the proposed house elsewhere.

Application of the Sequential Test requires that there are other suitable sites available that offer less risk in terms of flooding. Development of this site with the finished floor levels provides greater safety for the occupants than a similar site immediately adjacent to the flood risk area with levels marginally above the design flood risk level.

Hence this proposal provides greater protection to occupants than might be afforded by another notional site. Consequently, the Sequential Test would suggest that this site is one to which development should be moved. Indeed, using a pragmatic approach it is doubtful that the Sequential Test should be applied at all.

Since the publication of Planning Policy Guidance Note 25: Development and flood risk in July 2001 it has been a requirement that planning applications for residential uses located within Flood Zone 3 have to pass the Sequential Test (see para. 30 of PPG25). This was later re-iterated within Planning Policy Statement 25: Development and flood risk published in December 2006 and the NPPF published in March 2012 and subsequently updated.

A number of planning permissions all located within Flood Zone 3 have been granted by the Council for residential developments. Therefore, if these sites have been granted planning permission for residential developments and therefore have passed the Sequential Test the subject site should also be deemed to have passed the Sequential Test as the principle of development for residential uses within this area has already been decided since the introduction of the Sequential Test. It should be noted that these sites are at a greater risk of flooding from all sources than the subject site.

From the above it is shown that there are overriding sustainability reasons for the development to be granted planning permission within Flood Zone 3a. The development proposals should therefore be considered by the LPA to satisfy the Sequential Test as set out in the NPPF.

## 6.2 Exception Test

For the Exception Test to be passed:

a) It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA.

The key emphasis of the NPPF is to achieve sustainable development. The NPPF provides the following aims under the umbrella of sustainable development.

1. Building a strong, competitive economy
2. Ensuring the vitality of town centres
3. Supporting a prosperous rural economy
4. Promoting sustainable transport
5. Supporting high quality communications infrastructure
6. Delivering a wide choice of high-quality homes

7. Requiring good design
8. Promoting healthy communities
9. Protecting Green Belt land
10. Meeting the challenge of climate change, flooding and coastal change
11. Conserving and enhancing the natural environment
12. Conserving and enhancing the historic environment
13. Facilitating the sustainable use of mineral

The site is sustainable and within walking distance of the local community and services. The development of the site will improve the appearance of the site and make a positive contribution to as well as providing much a needed home in a highly sustainable location well-served by public transport and close to local facilities including schools.

The Councils' policies make clear for the need to focus on new development in locations which are accessible and sustainable, making use of existing infrastructure and community facilities and services. There is an important need within this area for affordable housing, which is suitable for a wide variety of people.

The added material benefit is the contribution that this site will make to the Councils' housing supply position in full compliance with the emerging strategic housing policy. There is an identified need for residential uses to meet future housing needs and accordingly there is a sound and strong planning reason for bringing the site forward.

These outcomes will provide wider sustainability benefits to the community that outweigh flood risk and will deliver considerably wider sustainability benefits than could conceivably only be achieved through use of the site for residential purposes. The development proposals should therefore be considered by the Council to satisfy the first condition of the Exceptions Test as set out in the NPPF.

b) A FRA must demonstrate that the development will be safe, without increasing flood risk elsewhere, and, where possible, reducing flood risk overall.

This FRA has demonstrated that the development will be safe, without increasing flood risk elsewhere.

The development proposals should therefore be considered by the LPA to satisfy the Exception Test as set out in the NPPF.

# 7.0 SUMMARY AND CONCLUSIONS

## 7.1 Introduction

This report presents a FRA in accordance with the NPPF for the proposed development at land adjacent to 93 Market Street, Millom, Cumbria, LA18 4AJ.

This FRA identifies and assesses the risks of all forms of flooding to and from the development and demonstrates how these flood risks will be managed so that the development remains safe throughout the lifetime, taking climate change into account.

## 7.2 Flood Risk

The site is unlikely to flood except in extreme conditions, the primary, but unlikely, flood risk posed to the site is from tidal flooding. The site is located within Flood Zone 2 and therefore has a 'medium probability' of flooding. Flood Zone 2 has between a 1 in 100 and 1 in 1000 annual probability of flooding (1% - 0.1%) in any year.

*Defended Scenario*

Considerable investment has been made in the provision of the flood defences to protect the area from tidal flooding. The site is currently protected against tidal flooding. The site will be flood free up to the defended 1 in 1000 year event. The actual flood risk posed to the site is low and is less than 1 in 1000 years therefore, the tidal flood risk posed to the site can be considered a residual risk. The actual flood risk posed to the site is low and is less than 1 in 1000 years. During the defended 1 in 200 year (plus climate change) event therefore, the site may be inundated with floodwater to a maximum depth of 0.28m.

Undefended Scenario

The flood defences can only protect up to a point, they may malfunction, can be breached and have a finite structure life. Therefore, there is a residual risk of tidal flooding. If the flood defences were not there, the area would be flooded. However, as area of land may benefit from the presence of flood defences even if the flood defences are overtopped, the presence of the flood defences means that the floodwater does not extend as far as it would if the flood defences were not there. It is unlikely

The site will not be inundated with floodwater for all events up to and including the undefended 1 in 200 year event. The site will be flood free during the undefended 1 in 200 year event, the residual flood risk posed to the site is low and is less than 1 in 200 years.

During the undefended 1 in 200 year (plus climate change) event, the site may be inundated with floodwater to a maximum depth of 1.65m and during the undefended 1 in 1000 year event a maximum depth of 0.51m would be experienced.

The actual flood risk posed to the site is less than the 1 in 1000 year event and the residual flood risk posed to the site is low and is less than 1 in 200 years. It can be concluded that tidal flooding from tidal flooding poses a low actual and residual risk to the site. Therefore, the risk of flooding from tidal flooding is considered to be of **medium significance**. A number of secondary flooding sources have been identified which may pose a **low significant** risk to the site. These are:

- Surface Water Flooding
- Sewer Flooding

The application is for a new, suitable flood-resilient design. The exposure of people and property will be reduced and minimised compared to existing site conditions. The chance of flooding each year is low each year. This takes into account the effect of any flood defences that may be located within the vicinity of the site as well property level protection measures.

### 7.3 SuDS Strategy

The SuDS Strategy ensures that a sustainable drainage solution can be achieved which reduces the peak discharge rate to manage and reduce the flood risk posed by the surface water runoff from the site. The SuDS Strategy takes into account the following principles:

- No increase in the volume or runoff rate of surface water runoff from the site.
- No increase in flooding to people or property off-site as a result of the development.
- No surface water flooding of the site.
- The proposals take into account a 40% increase in rainfall intensity due to climate change during the next 100 years which is the lifetime of the development.

In line with adopting a 'management train' it is recommended that water is managed as close to source as possible. This will reduce the size and cost of infrastructure further downstream and also shares the maintenance burden more equitably. It is therefore recommended that the site provides its own attenuation. This will be in the form of:

- Any areas of hardstanding areas (car parks, driveways etc.) within the development shall be constructed of a permeable surface including:
    - Using gravel or a mainly green, vegetated area.
    - Directing water from an impermeable surface to a border rain garden or soakaway.
    - Using permeable block paving, porous asphalt/concrete.
- Water butts/rainwater harvesting.
- Bioretention Areas/Tree Pits
- Underground attenuation storage.
- Discharge to the /public sewers at a restricted runoff rate.

For all development, both the Building Regulations and NPPF promote a hierarchical approach to surface water management. This approach has been adopted within this SuDS Strategy, infiltration is not possible and there are no watercourses located within the vicinity of the site therefore, discharge will be to the public sewers at a restricted runoff rate.

QBAR has been calculated to be 0.16l/s however, it is not possible to reduce surface water runoff to below 2.00l/s due to practical pipe sizes etc. Therefore, the surface water runoff from the site will be restricted to 2.00l/s before discharge to the public sewers after attenuation on the site.

As a consequence of limiting the rate of discharge from the site, at times of heavy rainfall the volume of water leaving the site will be significantly less than that draining from it. In order to prevent this water backing up in the system and causing flooding attenuation storage has been provided within the manholes and pipes within the system. The size of the attenuation storage has been calculated such that the proposed development has the capacity to accommodate the 1 in 100 year rainfall event including a 40% increase in rainfall intensity that is predicted to occur as a result of climate change. Consequently, all areas drained have been designed to accommodate a 100 year (+40% climate change) storm event. A storage volume of 4.50 to 9.00m$^3$ will be required.

Flooding will not occur on any part of the site during the 1 in 30 year event, no flooding will occur within any part of the buildings during the 1 in 100 year (+40%) event, all areas drained have been designed to accommodate the 1 in 100 year (+40%) event.

Surface water runoff would be directed to the drainage system through drainage gullies located around the perimeter of the buildings and through contouring of the hardstanding areas. These methods will reduce peak flows, the volume of runoff, and slow down flows and will provide a suitable SuDS solution for this site.

The adoption of a SuDS Strategy for the site represents an enhancement from the current conditions as the current surface water runoff from the site is uncontrolled, untreated, unmanaged and unmitigated. In adopting these principles, it has been demonstrated that a scheme can be developed that does not increase the risk of flooding to adjacent properties and development further downstream.

### 7.4 Risk Management

The property level mitigation measures detailed show that the flood risk can be effectively managed and therefore the consequences of flooding are acceptable. Measures used:

**Finished Floor Level:** The proposed finished floor levels will be set at 150mm above the external ground level at the location of the proposed house at approximately 5.44mAOD. It is recognised however, that owing to limited headroom constraints, massing, planning policy and Building Regulations, it is considered impractical to raise the finished floor levels further. A combination of resistance (proofing) and resilience measures will be included to further provide protection. This is discussed below.

**First Floor Accommodation:** Accommodation will be located on the first floor as well as the ground floor of the house. This will allow occupants to retreat to higher floor levels if needed. The levels of the first floor are located well above any floodwater levels

This provides a 'safe haven' above any floodwater levels. This will enable rapid escape should flooding occur which is unlikely. The upper floors are accessed via internal stairs and are sufficient in size to safely house all occupants of the building. The 'safe haven' will only be required in very extreme events or if a flood warning has not been received.

**Flood Resilience and Resistance:** To make the building more resistant to seepage the following measures will be incorporated. Sealant will be used around external doors and windows. All external doors and windows will be constructed from durable materials and the walls of the building will be thick.

To improve the buildings resilience to flooding the following measures will be incorporated. All electrical wiring, switches, sockets, socket outlets, electrical, and gas meters etc. will be located a minimum of 450mm above the finished floor level.

**Flood Plan:** A Flood Plan outlining the precautions and actions you should take when a flood event is anticipated to help reduce the impact and damage flooding may cause will be developed.

**Access and Egress Route:** A safe access and egress route, including emergency access can be maintained for vehicles and/or by foot. The site is at such a ground level that it would only flood in the most extreme flood event. Likewise, the access and egress route will remain dry in all but these most extreme scenarios. A safe access and egress route with minimum water depths would be possible for many hours if not days. This would provide more than an adequate amount of time for the site to be evacuated, if required.

The flood defence measures identified are expected to afford the site significant protection from tidal flooding. The site will be flood free during the defended 1 in 1000 year event. The actual flood risk posed to the site is low and is less than 1 in 1000 years. During the defended 1 in 200 year (plus climate change) event therefore, the site may be inundated with floodwater to a maximum depth of 0.28m and on the site access to a maximum depth 0.14m. Therefore, a safe access and egress route can be maintained for all events up to and including the defended 1 in 200 year (plus climate change) event in accordance with the NPPF and Environment Agency guidance.

### 7.5 Sequential Approach

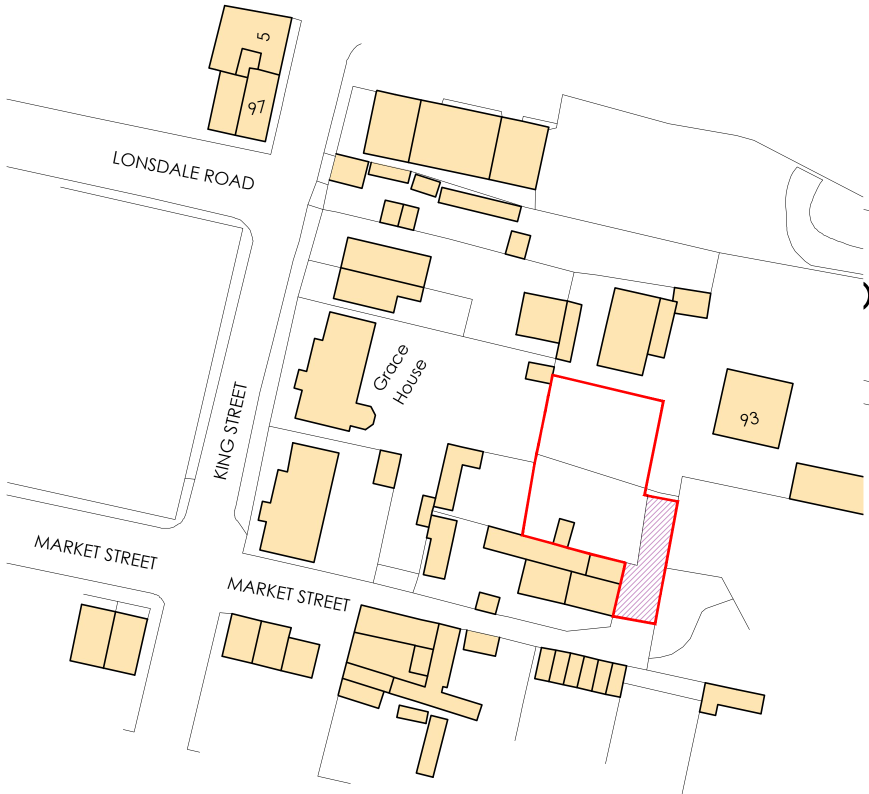
The development proposals should be considered by the LPA to satisfy the Sequential and Exception Tests as set out in the NPPF.

### 7.6 Conclusion

In conclusion, the erection of a new detached house, would be expected to remain dry in all but the most extreme conditions. Providing the recommendations made in this FRA are instigated, flood risk from all sources would be minimised, the consequences of flooding are acceptable, and the development would be in accordance with the requirements of the NPPF.

This FRA demonstrates that the proposed development would be operated with minimal risk from flooding, would not increase flood risk elsewhere and is compliant with the requirements of the NPPF. The development should not therefore be precluded on the grounds of flood risk.

# APPENDIX 1 – Proposed Site Layout




LOCATION PLAN @ 1:1250

0m 5 10 15 20 25m 50m 75m


BLOCK PLAN @ 1:500

0m 5 10 15 20 25m 50m

Ordnance Survey (c) Crown Copyright 2021. All rights reserved. Licence number 100022432

N

SITE APPLICATION BOUNDARY

SHARED ACCESS WITH NO.93

FOX-AD

DRAWING MAYBE SCALED FOR PLANNING PURPOSES ONLY!

ANY DISCREPANCIES TO BE DRAWN TO THE ATTENTION OF FOX-AD LTD

© FOX ARCHITECTURAL DESIGN LTD

| Rev. | Date | Description |
|---|---|---|
| A | 2022-03-17 | Site application boundary revised |

Client: CAMILLA FALLOWS

Project: PLOT NEXT TO 93 MARKET STREET - MILLOM

Title: LOCATION/BLOCK PLAN

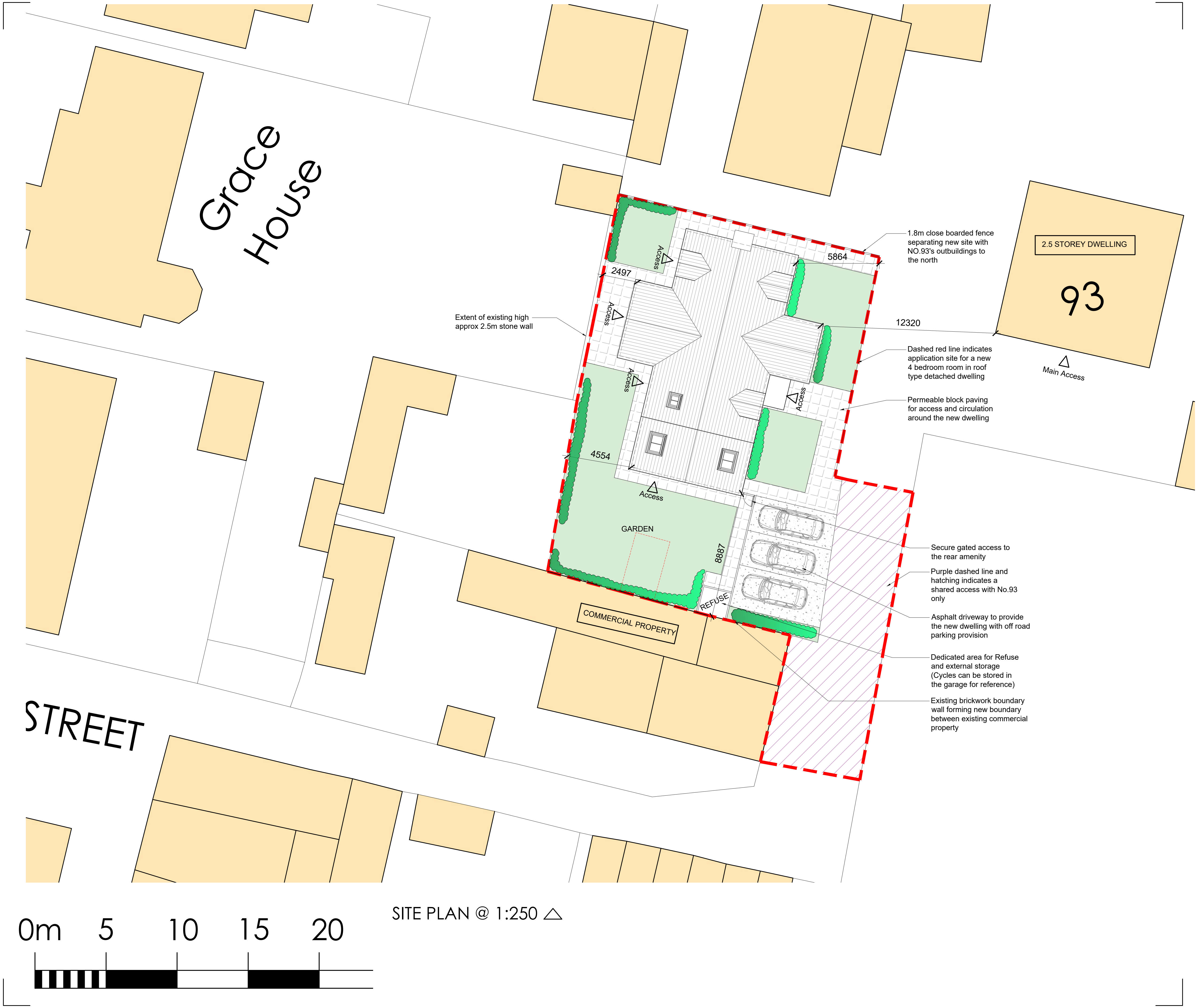
Scale: 1:1250/500@A3

Date: JANUARY 2022

Status: PLANNING

Drawing Reference: 21-55-P-L

Revision: A




SITE PLAN @ 1:250

SITE APPLICATION BOUNDARY

SHARED ACCESS WITH NO.93

FOX-AD

DRAWING MAYBE SCALED FOR PLANNING PURPOSES ONLY!

ANY DISCREPANCIES TO BE DRAWN TO THE ATTENTION OF FOX-AD LTD



| Rev. | Date | Description |
|---|---|---|
| A | 2022-03-17 | Site application boundary revised |

Client: CAMILLA FALLOWS

Project: PLOT NEXT TO 93 MARKET STREET - MILLOM

Title: PROPOSED SITE PLAN

Scale: 1:250@A3

Date: JANUARY 2022

Status: PLANNING

Drawing Reference: 21-55-P-01

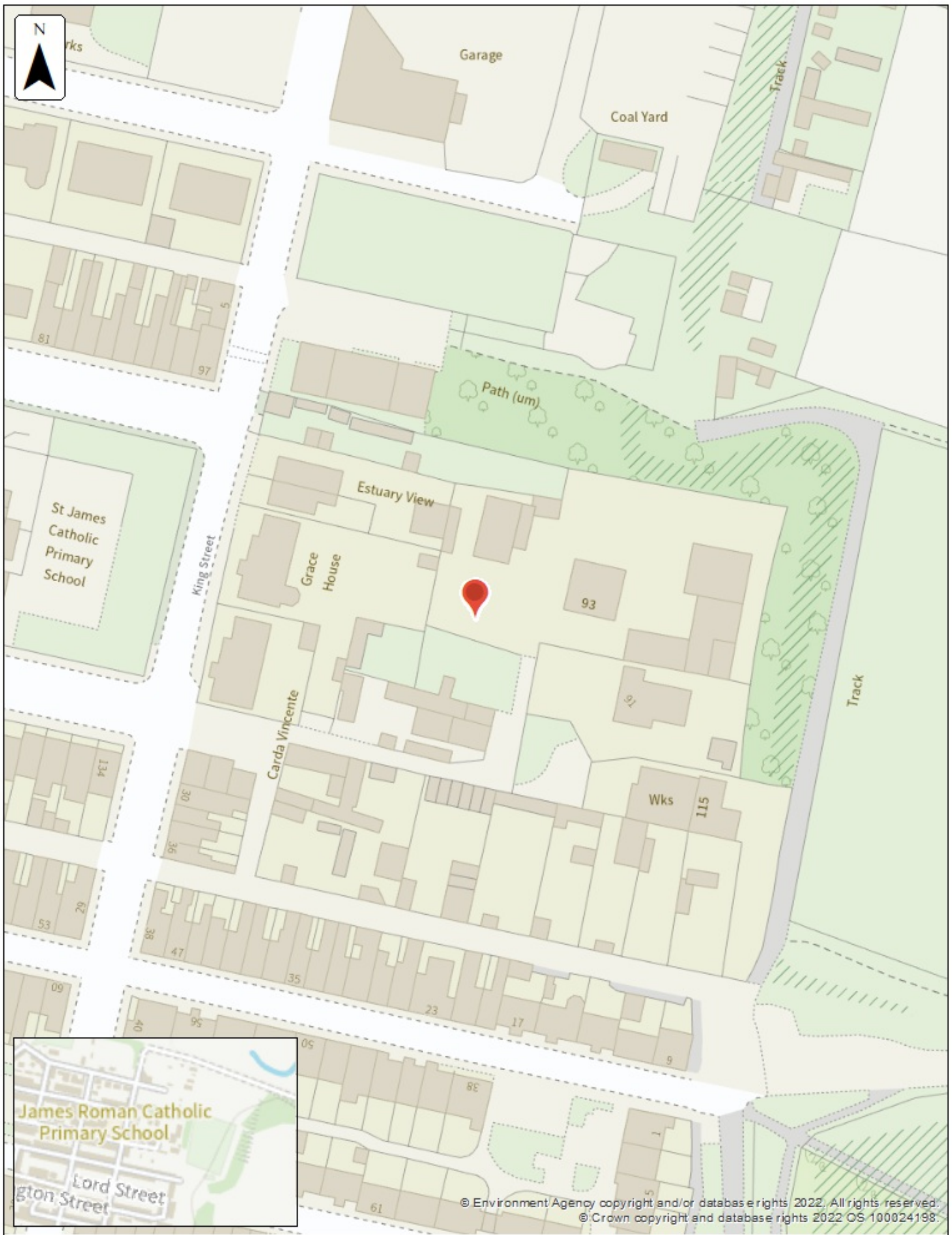
Revision: A

# APPENDIX 2 – Environment Agency Data

# Flood risk assessment data

**Location of site:** 317794 / 480163 (shown as easting and northing coordinates)
**Document created on:** 3 May 2022
**This information was previously known as a product 4.**
**Customer reference number:** GT5EA3TX8HMB

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





Selected location

**Site location**

Scale 1:1,000

0 10 20 30 40 50
metres

## 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)
- areas benefiting from defences
- 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

## Not included in this document

This document does not include a Flood Defence Breach Hazard Map.

As your location benefits from flood defences, you need to request a Flood Defence Breach Hazard Map and information about the level of flood protection offered at your location from the Cumbria and Lancashire Environment Agency team at inforequests.cmblnc@environment-agency.gov.uk. This information will only be available if modelling has been carried out for breach scenarios.

Include a site location map in your request.

## Information that's unavailable

This document **does not** contain:

- historic flooding
- flood defences and attributes

We do not have historic flooding data for this location. 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.

We aren't able to display flood defence locations and attributes. There are coastal defences managed by Copeland Borough Council at this location that we doesn’t hold any information on but the customer should be able to contact them directly to obtain the information.

## 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: Duddon Sands_Tidal 2012
Scenario(s): Defended tidal, defences removed tidal, defended climate change tidal, defences removed climate change tidal
Date: 1 July 2013

This model contains 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 development is in flood zone 2.

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

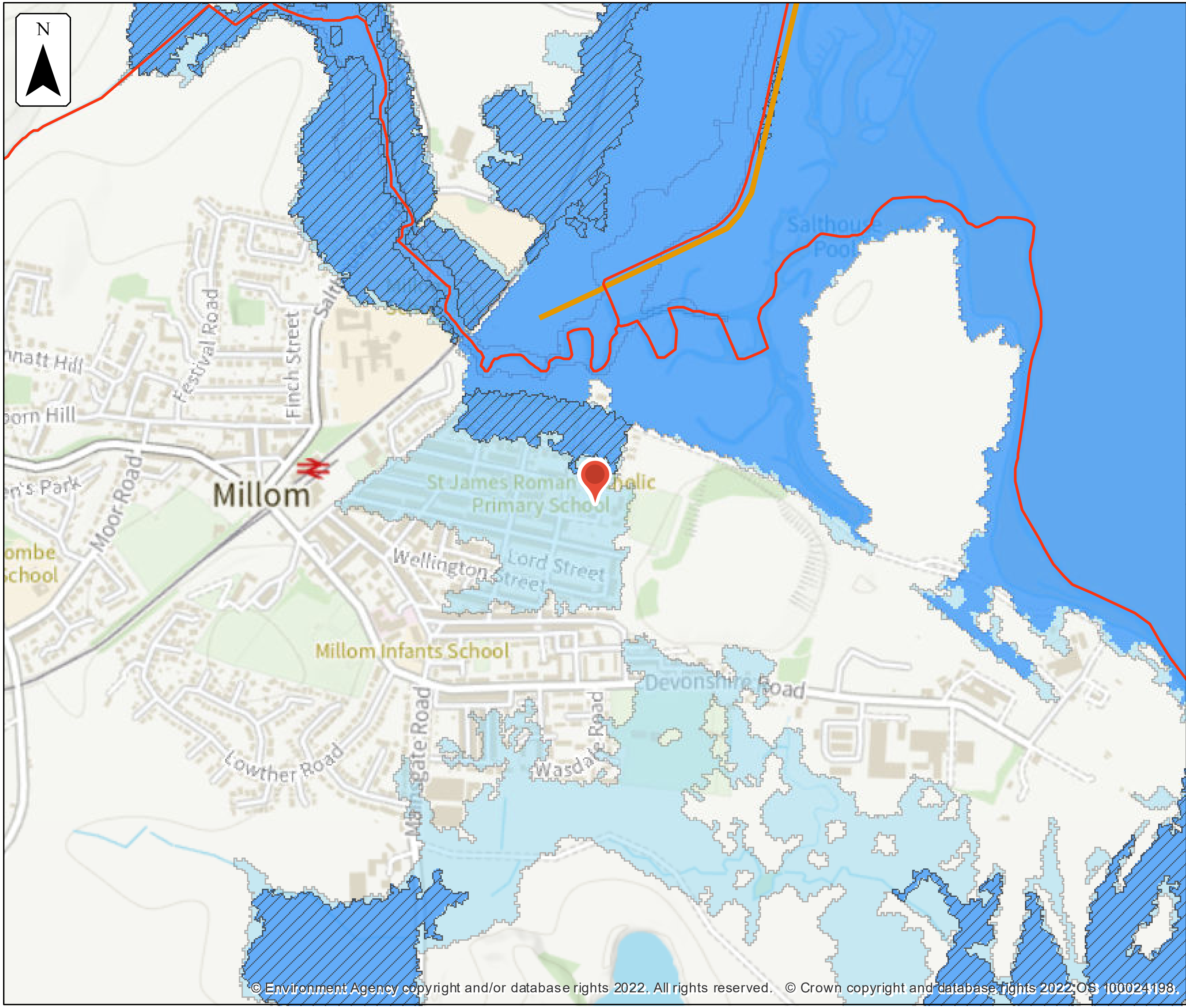
This data is updated on a quarterly basis as better data becomes available.

## Areas benefiting from defences

This map shows the areas benefiting from defences for 2 possible events:

- fluvial (river flooding) event that has a 1% annual exceedance probability (AEP), this means a 1% chance of occurring in any one year
- tidal or coastal event that has a 0.5% annual exceedance probability (AEP), this means a 0.5% chance of occurring in any one year

Download the GIS dataset for areas benefiting from defences






Environment Agency

**Flood map for planning**

Location (easting/northing)
**317794/480163**

Scale
**1:10,000**

Created
**3 May 2022**

Selected location

Main river

Flood defence

Areas benefiting from flood defence

Flood zone 3

Flood zone 2

0 100 200 300 400 500
metres

# 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
- 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

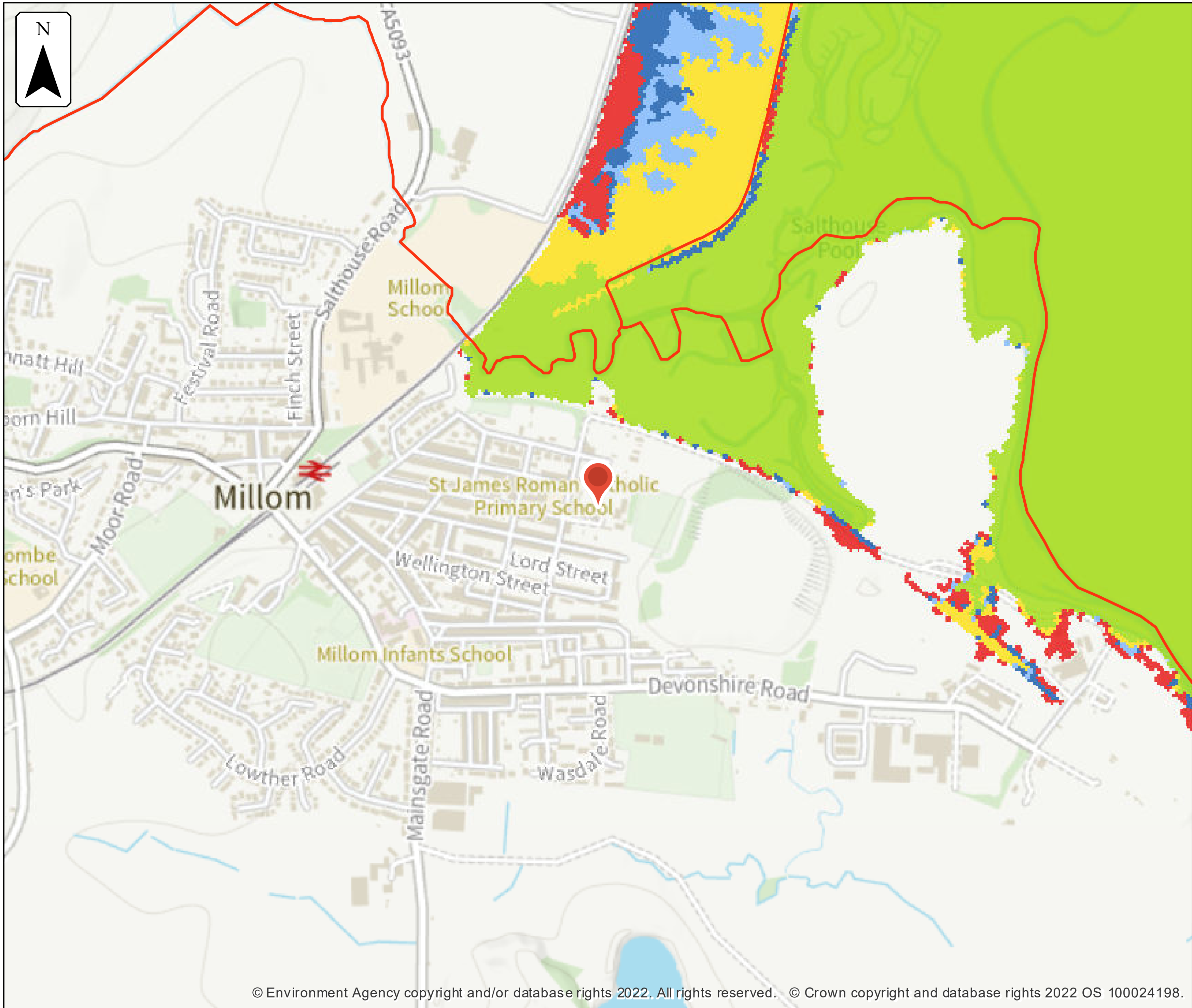
The climate change data included in the models may not include the latest flood risk assessment climate change allowances. Where the new allowances are not available you will need to consider this data and factor in the new allowances to demonstrate the development will be safe from flooding.

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 tidal: risk of flooding from the sea where there are flood defences
- Defences removed modelled tidal: risk of flooding from the sea where flood defences have been removed
- 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

**Defended modelled tidal extent**

Location (easting/northing)
**317794/480163**

Scale
**1:10,000**

Created
**3 May 2022**

Model name
**Duddon Sands Tidal 2012**

Selected location

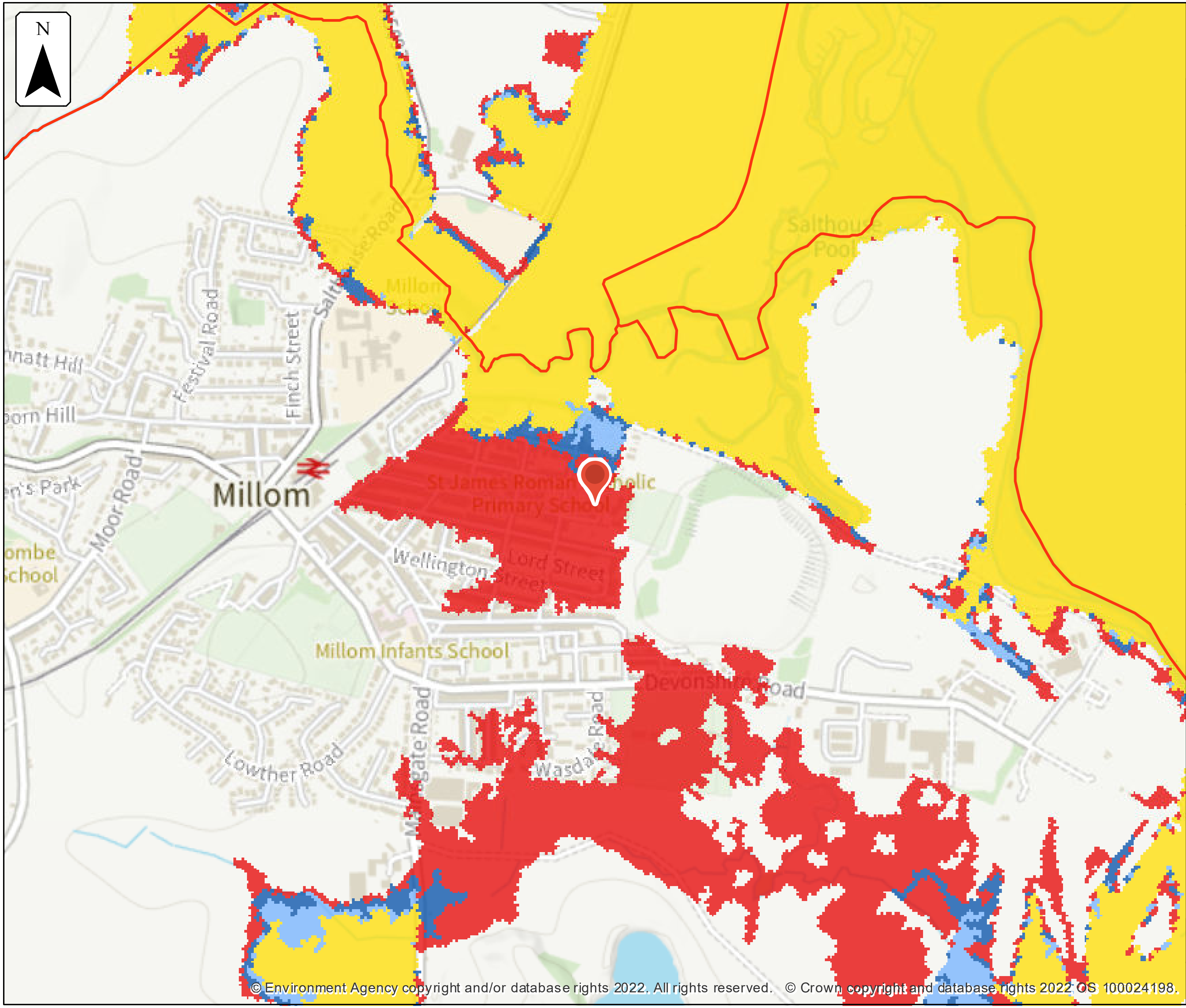
Main river

Modelled flood extent

- 5% 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 tidal extent**

Location (easting/northing)
**317794/480163**

Scale
**1:10,000**

Created
**3 May 2022**

Model name
**Duddon Sands Tidal 2012**

Selected location

Main river

Modelled flood extent

1.33% AEP

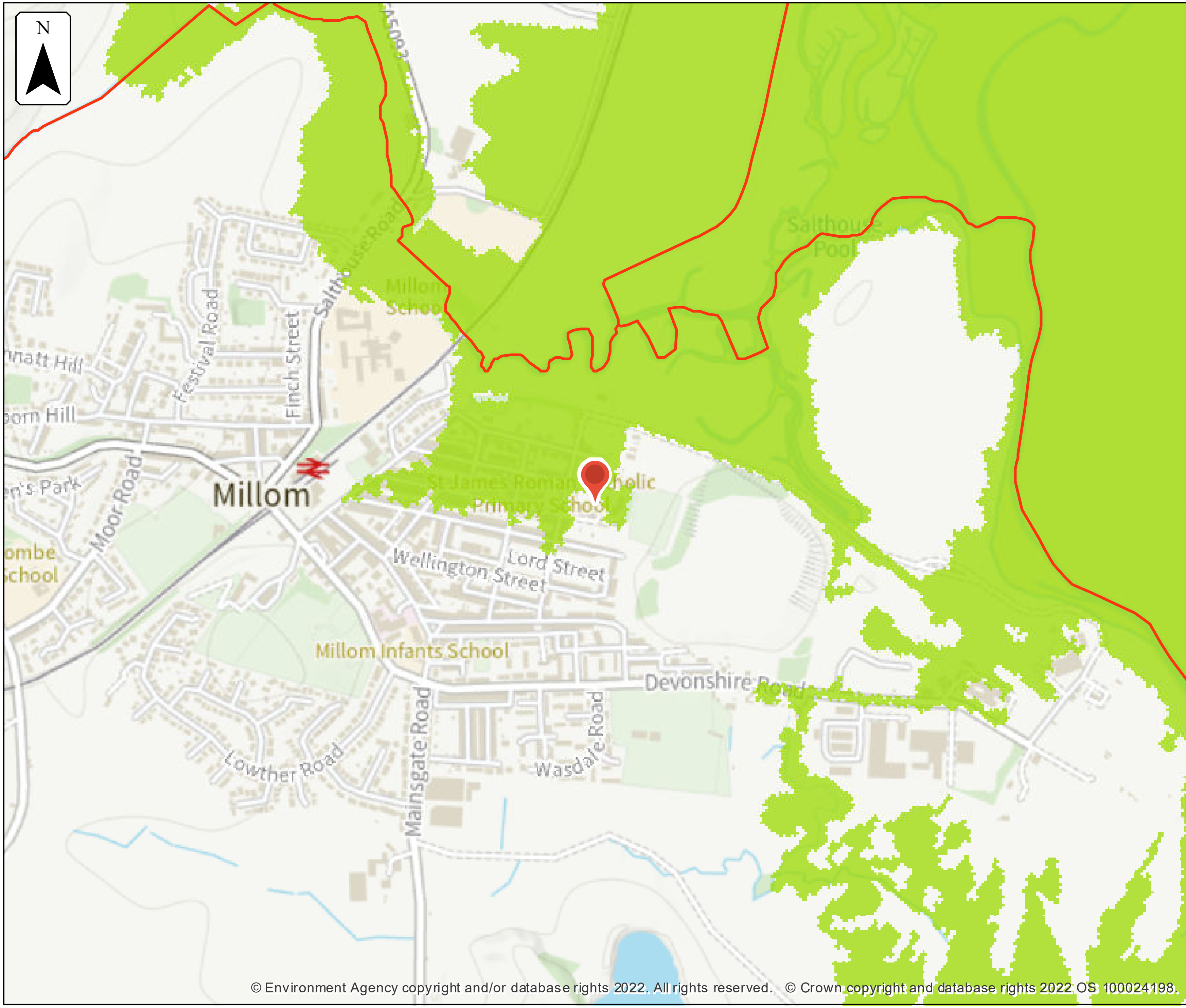
1% AEP

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

**Defended climate change modelled tidal extent**

Location (easting/northing)
**317794/480163**

Scale
**1:10,000**

Created
**3 May 2022**

Model name
**Duddon Sands Tidal 2012**

Selected location

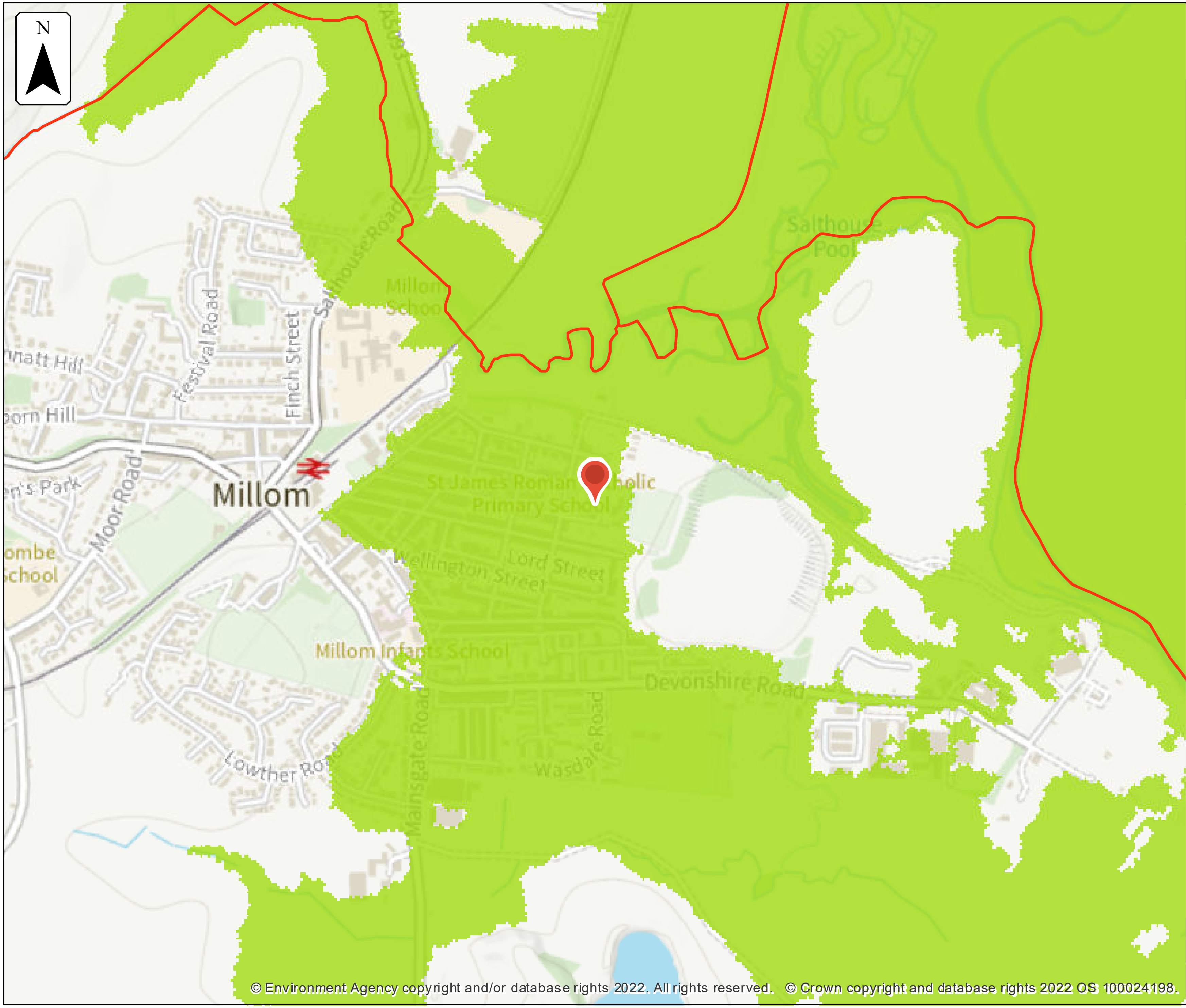
Main river

Modelled flood extent

0.5% AEP (+600mm)

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)
**317794/480163**

Scale
**1:10,000**

Created
**3 May 2022**

Model name
**Duddon Sands Tidal 2012**

Selected location

Main river

Modelled flood extent

0.5% AEP (+600mm)

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

0 100 200 300 400 500
metres




Environment Agency

**Defended modelled tidal extent and height**

Location (easting/northing)
**317794/480163**

Scale **1:2,500**

Created **3 May 2022**

Model name
**Duddon Sands Tidal 2012**

Selected location

Main river

Modelled 2D grid
*Water level in mAOD*

0 - 6.0
6.0 - 6.125
6.125 - 6.25
6.25 - 6.375
6.375 - 6.5
6.5 - 6.625
6.625 - 6.75
6.75 - 6.875
6.875 - 7.0

This map shows the 0.1% AEP height data

0 25 50 75 100
metres

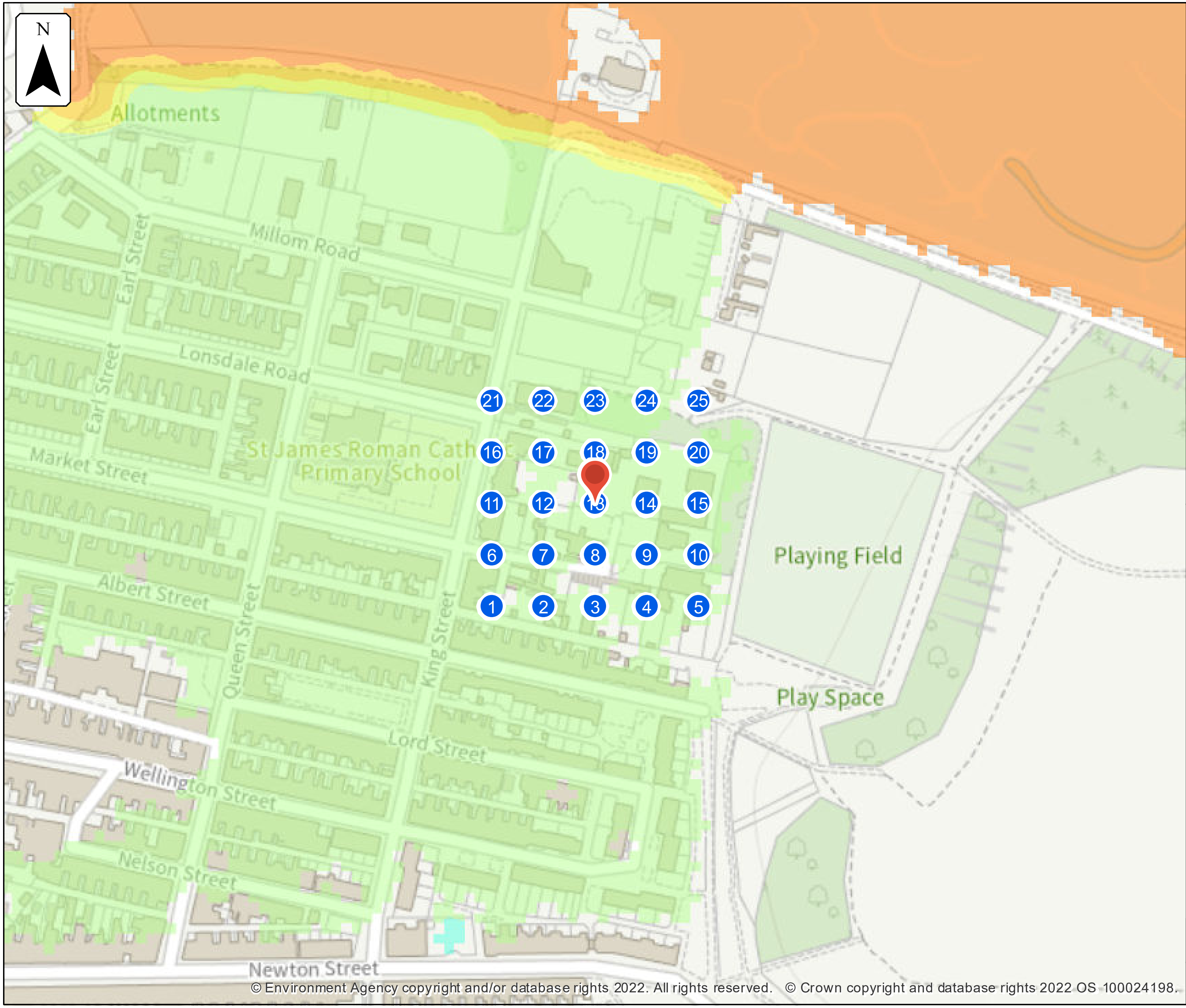
# Sample point data

## 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 | 317744 | 480113 | NoData | NoData | | | NoData | NoData | NoData | NoData | NoData | NoData | NoData | NoData |
| 2 | 317769 | 480113 | NoData | NoData | | | NoData | NoData | NoData | NoData | NoData | NoData | NoData | NoData |
| 3 | 317794 | 480113 | NoData | NoData | | | NoData | NoData | NoData | NoData | NoData | NoData | NoData | NoData |
| 4 | 317819 | 480113 | NoData | NoData | | | NoData | NoData | NoData | NoData | NoData | NoData | NoData | NoData |
| 5 | 317844 | 480113 | NoData | NoData | | | NoData | NoData | NoData | NoData | NoData | NoData | NoData | NoData |
| 6 | 317744 | 480138 | NoData | NoData | | | NoData | NoData | NoData | NoData | NoData | NoData | NoData | NoData |
| 7 | 317769 | 480138 | NoData | NoData | | | NoData | NoData | NoData | NoData | NoData | NoData | NoData | NoData |
| 8 | 317794 | 480138 | NoData | NoData | | | NoData | NoData | NoData | NoData | NoData | NoData | NoData | NoData |
| 9 | 317819 | 480138 | NoData | NoData | | | NoData | NoData | NoData | NoData | NoData | NoData | NoData | NoData |
| 10 | 317844 | 480138 | NoData | NoData | | | NoData | NoData | NoData | NoData | NoData | NoData | NoData | NoData |
| 11 | 317744 | 480163 | NoData | NoData | | | NoData | NoData | NoData | NoData | NoData | NoData | NoData | NoData |
| 12 | 317769 | 480163 | NoData | NoData | | | NoData | NoData | NoData | NoData | NoData | NoData | NoData | NoData |
| 13 | 317794 | 480163 | NoData | NoData | | | NoData | NoData | NoData | NoData | NoData | NoData | NoData | NoData |
| 14 | 317819 | 480163 | NoData | NoData | | | NoData | NoData | NoData | NoData | NoData | NoData | NoData | NoData |
| 15 | 317844 | 480163 | NoData | NoData | | | NoData | NoData | NoData | NoData | NoData | NoData | NoData | NoData |
| 16 | 317744 | 480188 | 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 | 317769 | 480188 | NoData | NoData | | | NoData | NoData | NoData | NoData | NoData | NoData | NoData | NoData |
| 18 | 317794 | 480188 | NoData | NoData | | | NoData | NoData | NoData | NoData | NoData | NoData | NoData | NoData |
| 19 | 317819 | 480188 | NoData | NoData | | | NoData | NoData | NoData | NoData | NoData | NoData | NoData | NoData |
| 20 | 317844 | 480188 | NoData | NoData | | | NoData | NoData | NoData | NoData | NoData | NoData | NoData | NoData |
| 21 | 317744 | 480213 | NoData | NoData | | | NoData | NoData | NoData | NoData | NoData | NoData | NoData | NoData |
| 22 | 317769 | 480213 | NoData | NoData | | | NoData | NoData | NoData | NoData | NoData | NoData | NoData | NoData |
| 23 | 317794 | 480213 | NoData | NoData | | | NoData | NoData | NoData | NoData | NoData | NoData | NoData | NoData |
| 24 | 317819 | 480213 | NoData | NoData | | | NoData | NoData | NoData | NoData | NoData | NoData | NoData | NoData |
| 25 | 317844 | 480213 | NoData | NoData | | | NoData | NoData | NoData | NoData | NoData | NoData | NoData | NoData |

Data in this table comes from the Duddon Sands Tidal 2012 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 tidal extent and height**

Location (easting/northing)
**317794/480163**

Scale
**1:2,500**

Created
**3 May 2022**

Model name
**Duddon Sands Tidal 2012**

Selected location

Main river

Modelled 2D grid
*Water level in mAOD*

0 - 5.0
5.0 - 5.25
5.25 - 5.5
5.5 - 5.75
5.75 - 6.0
6.0 - 6.25
6.25 - 6.5
6.5 - 6.75
6.75 - 7.0

This map shows the 0.1% AEP height data

0 25 50 75 100
metres

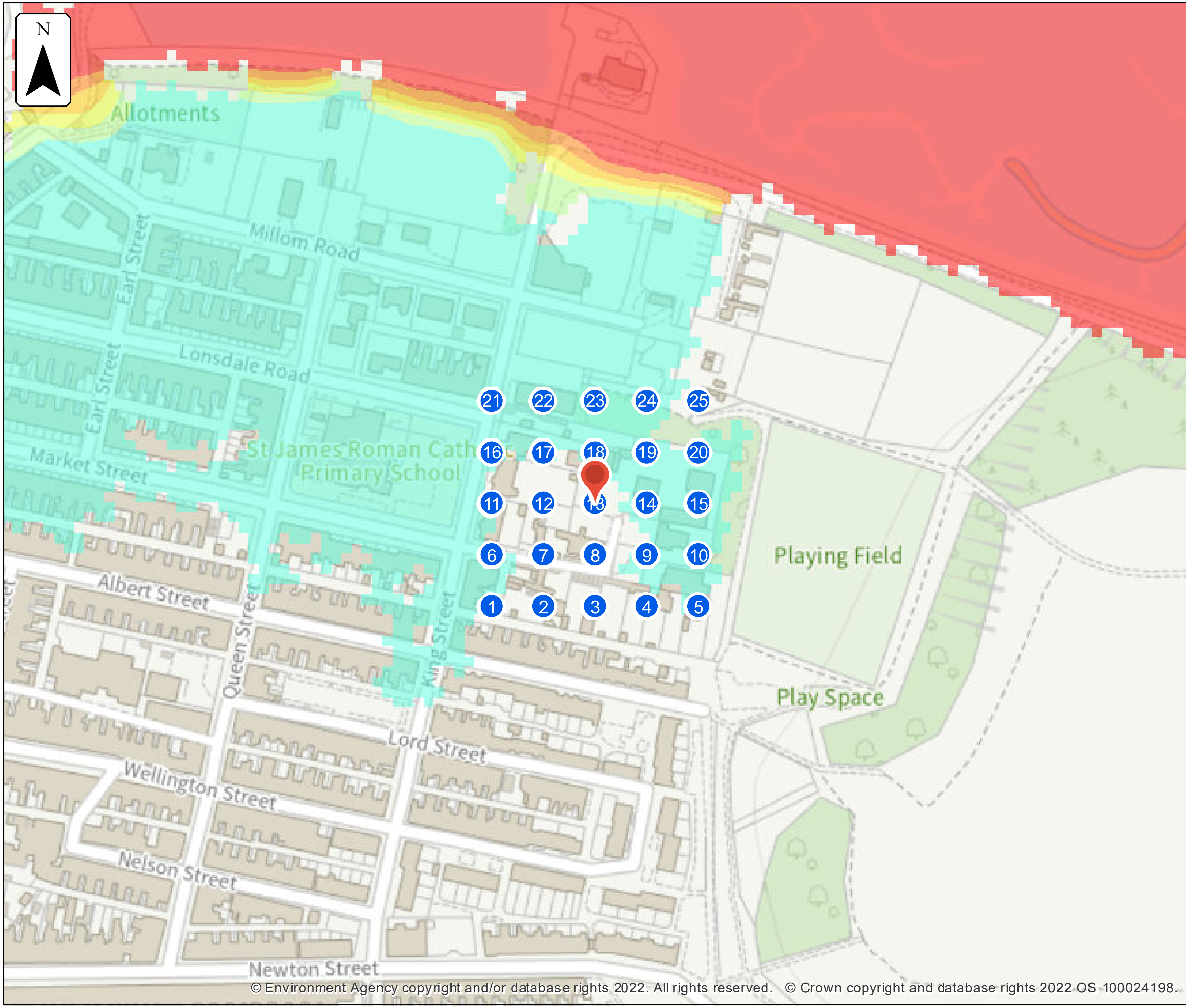
## Sample point data

### 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 | 317744 | 480113 | | | | | NoData | NoData | NoData | NoData | NoData | NoData | 0.20 | 5.78 |
| 2 | 317769 | 480113 | | | | | NoData | NoData | NoData | NoData | NoData | NoData | 0.01 | 5.78 |
| 3 | 317794 | 480113 | | | | | NoData | NoData | NoData | NoData | NoData | NoData | 0.03 | 5.78 |
| 4 | 317819 | 480113 | | | | | NoData | NoData | NoData | NoData | NoData | NoData | 0.14 | 5.79 |
| 5 | 317844 | 480113 | | | | | NoData | NoData | NoData | NoData | NoData | NoData | 0.30 | 5.79 |
| 6 | 317744 | 480138 | | | | | NoData | NoData | NoData | NoData | NoData | NoData | 0.35 | 5.79 |
| 7 | 317769 | 480138 | | | | | NoData | NoData | NoData | NoData | NoData | NoData | 0.11 | 5.79 |
| 8 | 317794 | 480138 | | | | | NoData | NoData | NoData | NoData | NoData | NoData | NoData | NoData |
| 9 | 317819 | 480138 | | | | | NoData | NoData | NoData | NoData | NoData | NoData | 0.32 | 5.79 |
| 10 | 317844 | 480138 | | | | | NoData | NoData | NoData | NoData | NoData | NoData | 0.55 | 5.79 |
| 11 | 317744 | 480163 | | | | | NoData | NoData | NoData | NoData | NoData | NoData | 0.28 | 5.79 |
| 12 | 317769 | 480163 | | | | | NoData | NoData | NoData | NoData | NoData | NoData | 0.05 | 5.79 |
| 13 | 317794 | 480163 | | | | | NoData | NoData | NoData | NoData | NoData | NoData | 0.05 | 5.79 |
| 14 | 317819 | 480163 | | | | | NoData | NoData | NoData | NoData | NoData | NoData | 0.62 | 5.79 |
| 15 | 317844 | 480163 | | | | | NoData | NoData | NoData | NoData | NoData | NoData | 1.03 | 5.79 |
| 16 | 317744 | 480188 | | | | | NoData | NoData | NoData | NoData | NoData | NoData | 0.51 | 5.79 |

| 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 | 317769 | 480188 | | | | | NoData | NoData | NoData | NoData | NoData | NoData | 0.27 | 5.79 |
| 18 | 317794 | 480188 | | | | | NoData | NoData | NoData | NoData | NoData | NoData | 0.32 | 5.79 |
| 19 | 317819 | 480188 | | | | | NoData | NoData | NoData | NoData | NoData | NoData | 0.60 | 5.79 |
| 20 | 317844 | 480188 | | | | | NoData | NoData | NoData | NoData | NoData | NoData | 0.72 | 5.79 |
| 21 | 317744 | 480213 | | | | | NoData | NoData | NoData | NoData | NoData | NoData | 0.90 | 5.79 |
| 22 | 317769 | 480213 | | | | | NoData | NoData | NoData | NoData | NoData | NoData | 0.99 | 5.79 |
| 23 | 317794 | 480213 | | | | | NoData | NoData | NoData | NoData | NoData | NoData | 0.86 | 5.79 |
| 24 | 317819 | 480213 | | | | | NoData | NoData | NoData | NoData | NoData | NoData | 0.88 | 5.79 |
| 25 | 317844 | 480213 | | | | | NoData | NoData | NoData | NoData | NoData | NoData | NoData | NoData |

Data in this table comes from the Duddon Sands Tidal 2012 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 and height**

Location (easting/northing)
**317794/480163**

Scale **1:2,500**

Created **3 May 2022**

Model name
**Duddon Sands Tidal 2012**

Selected location

Main river

Modelled 2D grid
*Water level in mAOD*

- 0 - 5.0
- 5.0 - 5.25
- 5.25 - 5.5
- 5.5 - 5.75
- 5.75 - 6.0
- 6.0 - 6.25
- 6.25 - 6.5
- 6.5 - 6.75
- 6.75 - 7.0

This map shows the 0.5% AEP +600mm height data

0 25 50 75 100
metres

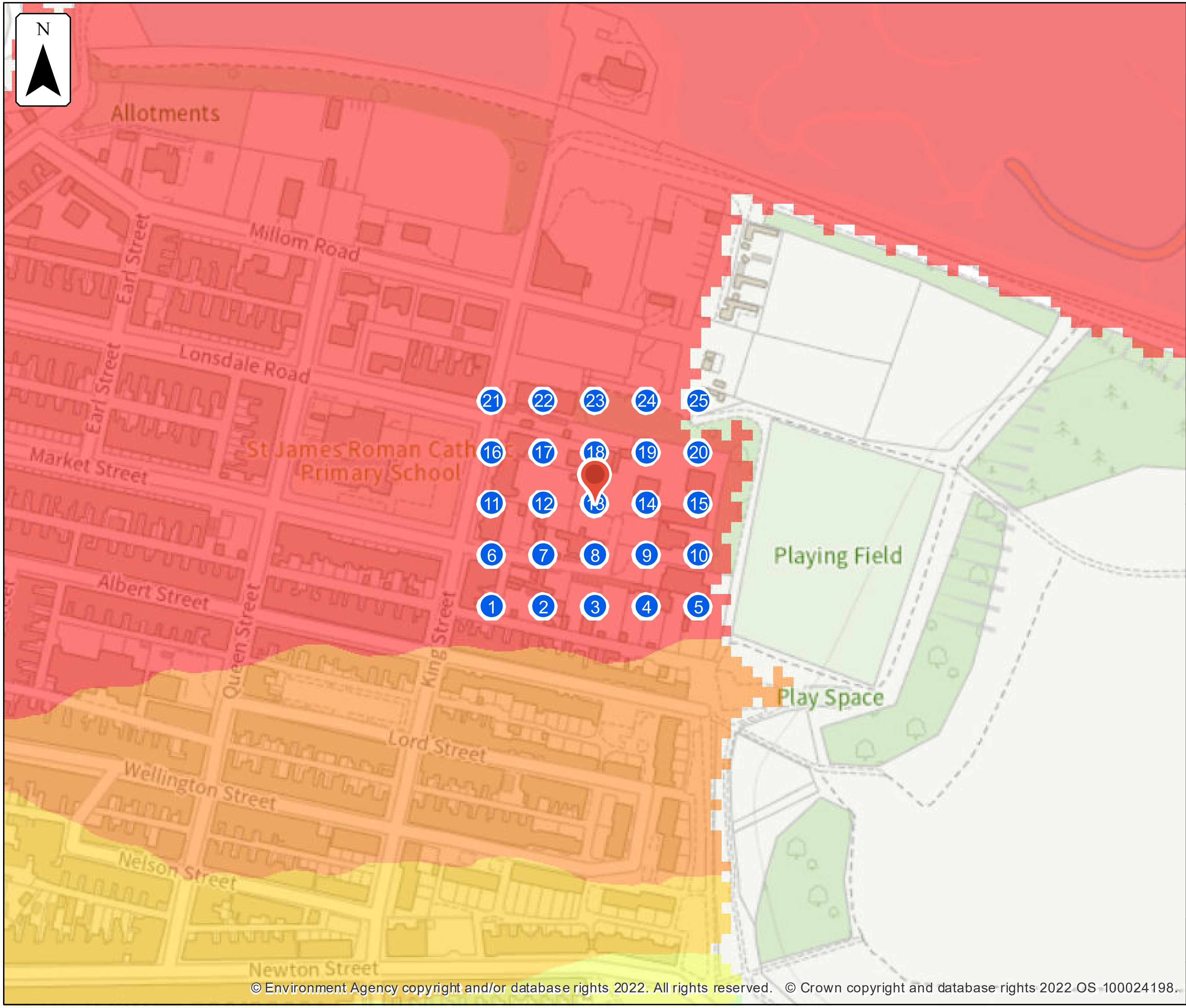
# Sample point data

## Defended climate change

| Label | Easting | Northing | 0.5% AEP (+600mm) | |
|---|---|---|---|---|
| | | | Depth | Height |
| 1 | 317744 | 480113 | NoData | NoData |
| 2 | 317769 | 480113 | NoData | NoData |
| 3 | 317794 | 480113 | NoData | NoData |
| 4 | 317819 | 480113 | NoData | NoData |
| 5 | 317844 | 480113 | NoData | NoData |
| 6 | 317744 | 480138 | 0.14 | 5.57 |
| 7 | 317769 | 480138 | NoData | NoData |
| 8 | 317794 | 480138 | NoData | NoData |
| 9 | 317819 | 480138 | 0.09 | 5.57 |
| 10 | 317844 | 480138 | 0.33 | 5.57 |
| 11 | 317744 | 480163 | NoData | NoData |
| 12 | 317769 | 480163 | NoData | NoData |
| 13 | 317794 | 480163 | NoData | NoData |
| 14 | 317819 | 480163 | 0.40 | 5.57 |
| 15 | 317844 | 480163 | 0.81 | 5.57 |
| 16 | 317744 | 480188 | 0.28 | 5.57 |

| Label | Easting | Northing | 0.5% AEP (+600mm) | |
|---|---|---|---|---|
| | | | Depth | Height |
| 17 | 317769 | 480188 | NoData | NoData |
| 18 | 317794 | 480188 | 0.10 | 5.57 |
| 19 | 317819 | 480188 | 0.38 | 5.57 |
| 20 | 317844 | 480188 | 0.56 | 5.57 |
| 21 | 317744 | 480213 | 0.67 | 5.57 |
| 22 | 317769 | 480213 | 0.77 | 5.57 |
| 23 | 317794 | 480213 | 0.64 | 5.57 |
| 24 | 317819 | 480213 | 0.65 | 5.57 |
| 25 | 317844 | 480213 | NoData | NoData |

Data in this table comes from the Duddon Sands Tidal 2012 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 tidal extent and height**

Location (easting/northing)
**317794/480163**

Scale
**1:2,500**

Created
**3 May 2022**

Model name
**Duddon Sands Tidal 2012**

Selected location

Main river

Modelled 2D grid
*Water level in mAOD*

0 - 6.0
6.0 - 6.125
6.125 - 6.25
6.25 - 6.375
6.375 - 6.5
6.5 - 6.625
6.625 - 6.75
6.75 - 6.875
6.875 - 7.0

This map shows the 0.5% AEP +600mm height data

0 25 50 75 100
metres

# Sample point data

## Defences removed climate change

| Label | Easting | Northing | 0.5% AEP (+600mm) | |
|---|---|---|---|---|
| | | | Depth | Height |
| 1 | 317744 | 480113 | 1.32 | 6.89 |
| 2 | 317769 | 480113 | 1.07 | 6.89 |
| 3 | 317794 | 480113 | 1.11 | 6.89 |
| 4 | 317819 | 480113 | 1.24 | 6.89 |
| 5 | 317844 | 480113 | 1.37 | 6.89 |
| 6 | 317744 | 480138 | 1.47 | 6.91 |
| 7 | 317769 | 480138 | 1.23 | 6.91 |
| 8 | 317794 | 480138 | 1.05 | 6.90 |
| 9 | 317819 | 480138 | 1.43 | 6.91 |
| 10 | 317844 | 480138 | 1.67 | 6.91 |
| 11 | 317744 | 480163 | 1.41 | 6.92 |
| 12 | 317769 | 480163 | 1.18 | 6.92 |
| 13 | 317794 | 480163 | 1.17 | 6.91 |
| 14 | 317819 | 480163 | 1.75 | 6.92 |
| 15 | 317844 | 480163 | 2.16 | 6.92 |
| 16 | 317744 | 480188 | 1.65 | 6.93 |

| Label | Easting | Northing | 0.5% AEP (+600mm) | |
|---|---|---|---|---|
| | | | Depth | Height |
| 17 | 317769 | 480188 | 1.40 | 6.93 |
| 18 | 317794 | 480188 | 1.46 | 6.93 |
| 19 | 317819 | 480188 | 1.74 | 6.92 |
| 20 | 317844 | 480188 | 1.75 | 6.92 |
| 21 | 317744 | 480213 | 2.04 | 6.94 |
| 22 | 317769 | 480213 | 2.14 | 6.94 |
| 23 | 317794 | 480213 | 2.01 | 6.94 |
| 24 | 317819 | 480213 | 2.02 | 6.94 |
| 25 | 317844 | 480213 | NoData | NoData |

Data in this table comes from the Duddon Sands Tidal 2012 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 3 – Surface Water Drainage Calculations

# Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

| | |
|---|---|
| Calculated by: | Keelan Serjeant |
| Site name: | 93 Market Street |
| Site location: | Millom |

**Site Details**

| | |
|---|---|
| Latitude: | 54.21054° N |
| Longitude: | 3.26221° W |
| Reference: | 3454178610 |
| Date: | May 23 2022 13:09 |

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.

**Runoff estimation approach** IH124

**Site characteristics**

Total site area (ha): 0.02

**Methodology**

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

| **Soil characteristics** | Default | Edited |
|---|---|---|
| SOIL type: | 4 | 4 |
| HOST class: | N/A | N/A |
| SPR/SPRHOST: | 0.47 | 0.47 |

| **Hydrological characteristics** | Default | Edited |
|---|---|---|
| SAAR (mm): | 1070 | 1070 |
| 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.

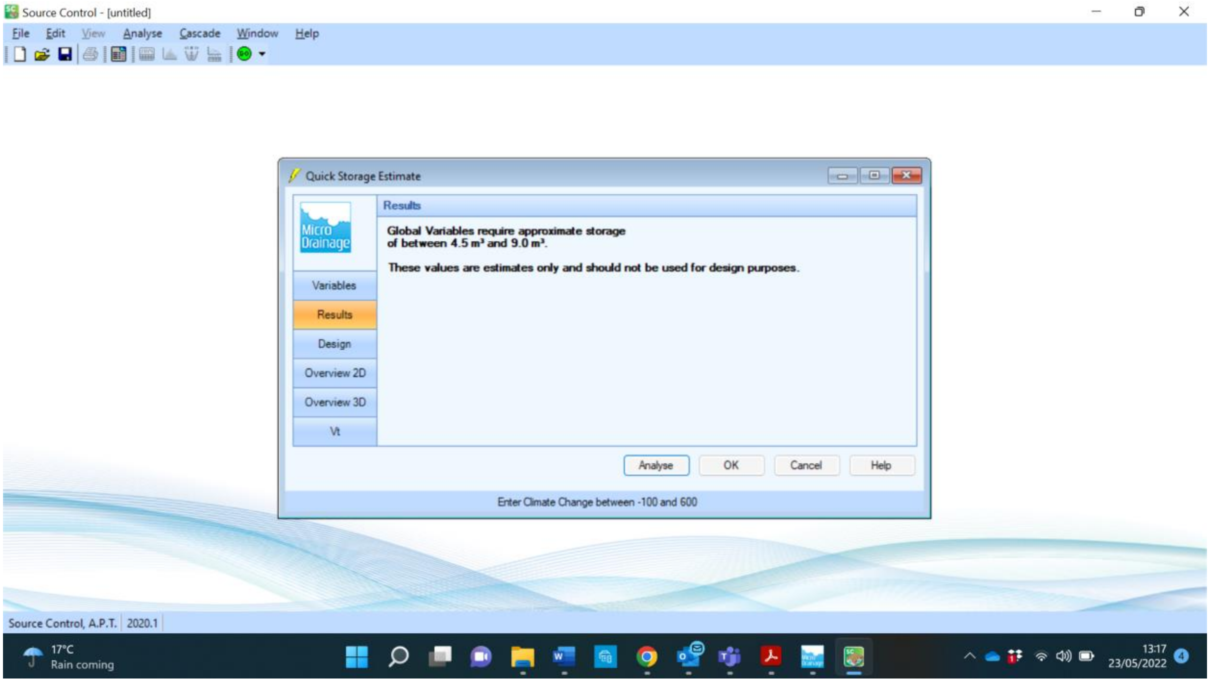
**(2) Are flow rates < 5.0 l/s?**

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): | 0.16 | 0.16 |
| 1 in 1 year (l/s): | 0.14 | 0.14 |
| 1 in 30 years (l/s): | 0.27 | 0.27 |
| 1 in 100 year (l/s): | 0.33 | 0.33 |
| 1 in 200 years (l/s): | 0.38 | 0.38 |


Source Control - [untitled]
File Edit View Analyse Cascade Window Help
Quick Storage Estimate
Micro Drainage
Results
Global Variables require approximate storage
of between 4.5 m³ and 9.0 m³.
These values are estimates only and should not be used for design purposes.
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Analyse
OK
Cancel
Help
Enter Climate Change between -100 and 600
Source Control, A.P.T.
2020.1
17°C
Rain coming
13:17
23/05/2022

KRS Environmental Ltd
Mob: 07857 264 376
Tel: 01686 668957
Tel: 01484 437420
Email: keelan@krsenvironmental.com
Web: www.krsenvironmental.com