

Appendix F



Flood Risk Assessment & Surface Water Drainage Strategy

Priddys Hard
Gosport, Hampshire



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1. Introduction

- 1.1. Instructions were received from Portsmouth Naval Base Property Trust to undertake a Flood Risk Assessment (FRA) and Outline Surface Water Drainage Strategy (SDS) for a planning application for the change of use of two buildings to holiday-let accommodation on land within Priddys Hard Explosion museum hereafter referred to as parcels M and U, in addition a new building for holiday-let accommodation is also proposed on land to the eastern edge of the museum premises, hereafter referred to as parcel U2.
- 1.2. The assessment has been reviewed by A P Traves BSc CEng MIStructE MCIHT.
- 1.3. The client's attention is drawn to the conditions and limitations contained in Appendix D.

2. Development Description & Location

- 2.1. The total development footprints comprise approximately 0.05 Ha on land at Priddys Hard, Gosport, Hampshire (approximate grid reference SU616012). The extents of parcels M, U and U2 are indicated on the annotated aerial photograph in Appendix A. The existing topography is shown on a drawing contained in Appendix A of this report.
- 2.2. Parcels M and U comprises existing buildings, and parcel U2 is laid to grass.
- 2.3. For parcels M and U it is proposed to change the use of two buildings to form holiday-let accommodation. For parcel U2 it is proposed to develop a new building to serve as holiday-let accommodation. The proposed layout is identified on Hampshire County Council's drawings E02702-P2321 & E02702-P2621 contained in Appendix A of this report.

3. Local Development Documents & Strategic Flood Risk Assessment

- 3.1. The Partnership for Urban South Hampshire (PUSH) Strategic Flood Risk Assessment (SFRA) has been reviewed (refer to appendix for local mapping) and this indicates the following.
- 3.2. SFRA map set 1A indicates that land to the west of parcel M is in flood zone 2 and land to the east of parcel M is in flood zone 3. Similarly land to the west of parcel U is in flood zone 2 and land to the east of parcel U is in flood zone 3. The land at the proposed position of parcel U2 is currently in flood zone 3.
- 3.3. SFRA map set 1B indicates the parcels are not within a hazard zone.
- 3.4. SFRA map set 1C indicates the parcels are not within a flood zone 3 breach risk area.
- 3.5. SFRA map set 1D indicates the parcels are within in 2115_{AD} climate change tidal flood zone 3.
- 3.6. SFRA map set 1E indicates the northern part of the site, including parcels U and U2, overlies moderate permeability bedrock. The southern part of the site, including parcel M, overlies low permeability bedrock. The site is not in a historic groundwater flooding area.
- 3.7. SFRA map set 1F indicates the site has had no observed sewer flooding incidents.
- 3.8. SFRA map set 1G indicates the site is not in an historic flood zone.
- 3.9. SFRA map set 1H indicates that the site does not contain a surface water flood risk.
- 3.10. Flood mapping data has also been reviewed from the EA website (refer to Appendix for local mapping). This indicates the following:
- 3.11. The EA mapping indicates that land to the west of parcel M is in flood zone 2 and land to the east of parcel M is in flood zone 3. Similarly land to the west of parcel U is in flood zone 2 and land to the east of parcel U is in flood zone 3. The land at the proposed position of parcel U2 is currently in flood zone 3.
- 3.12. The EA mapping indicates the flood zone 2 areas to be at low risk (0.1%-1%AEP) of flooding from the rivers and seas. The flood zone 3 areas are at medium risk (1%-3.3%AEP) of flooding from the rivers and sea.

- 3.13. It should be noted that both the SFRA and EA mapping are not cognisant of the existing building FFLs. Building M FFLs are 3.30-3.51m AOD save for a small lobby area at the foot of the ramps at 3.14m AOD. Building U FFL is just over 3.20m AOD. This compares to an existing FZ2 level of 3.1m AOD_{2000AD} + 0.004 x 17 years = 3.17m AOD_{2017AD}, and FZ1 level of 3.37m AOD_{2017AD}. Building M is therefore considered to be FZ1 and Building U is considered to be FZ2.
- 3.14. The EA mapping indicates the site is not in an area at risk of flooding from reservoirs.
- 3.15. The EA mapping indicates the site is at a very low risk (<0.1%AEP) of surface water flooding.
- 3.16. The EA mapping indicates the site is not in a Source Protection Zone (SPZ).
- 3.17. The EA mapping indicates the site is not within a safeguarded zone for drinking water from groundwater or surface water.

4. Catchment Flood Management & Shoreline Management Plans

- 4.1. The North Solent Shoreline Management Plan (SMP) has been reviewed and the following salient points have been noted:
- 4.2. The site is located in Policy Unit 5A25, which covers the stretch of shoreline extending from Quay Lane (MOD Boundary) to Portsmouth Harbour entrance.
- 4.3. North Solent Shoreline Management Plan chapter 5 discusses detailed policy development, with Policy Unit 5A25 discussed on pages 177-179. A summary description of the policy area is as follows:

“The developed area within the tidal floodplain includes a wide range of assets and facilities, including residential properties in Gosport, transport network, and commercial assets such as marinas, along with significant MOD assets. Part of the shoreline and hinterland area is located on a former landfill site. The existing defences are owned and maintained by the MOD, Local Authority and private individuals...Heritage features include Scheduled Ancient Monuments, listed and historic buildings, Parks and Gardens, Monuments and maritime features, along with Conservation Areas.

The North Solent Shoreline Management Plan recommends a Hold the Line (HTL) policy over the three epochs within the extent covered by Policy Unit 5A25. The rationale behind the policy is summarised as follows:

“The key drivers to continuing to hold the existing defence line will be to provide flood protection to the developed conurbation within the tidal floodplain that includes the residential centre of Gosport, transport networks critical to Gosport, a wide range of MOD assets and facilities, and commercial assets such as marinas.”

- 4.4. The South East Hampshire Catchment Flood Management Plan summary – December 2009 (CFMP) indicates the site falls within Policy sub-area 1 Portsmouth & Langstone Harbours. The CFMP states that Policy 5 is the preferred policy approach:

“Areas of moderate to high flood risk where we can generally take further action to reduce flood risk. This policy will tend to be applied to those areas where the case for further action to reduce flood risk is most compelling, for example where there are many people at high risk, or where changes in the environment have already increased risk. Taking further action to reduce risk will require additional appraisal to assess whether there are socially and environmentally sustainable, technically viable and economically justified options.”

- 4.5. Overall the SMP and CFMP do not present any issues that would prohibit the development of this site with respect to flood issues provided the surface water drainage is based on SuDS principles.

5. Catchment Data

- 5.1. The BGS mapping indicates the site is underlain by London Clay geology. The existing museum premises has a high percentage impermeable surfacing and the surface water system is generally historic and tends to discharge directly into the tidal waters of Portsmouth Harbour.

6. Sewage Authority Data

- 6.1. The site has existing connection to the public sewer network which will continue to service the development.

7. Site Reconnaissance

- 7.1. A site reconnaissance was undertaken in October 2017. Parcels M and U comprise existing buildings.
- 7.2. The land adjacent the parcels comprises a museum with associated pavements, outbuildings to the north, south and west. Portsmouth Harbour is located to the east.
- 7.3. The land at parcels M and U nominally falls from west to east, toward Portsmouth Harbour. Surface water runoff from the existing buildings discharges into Portsmouth Harbour.
- 7.4. Parcel U2 is laid to grass.
- 7.5. The land adjacent the parcel comprises a museum with associated pavements, outbuildings to the south and west. Portsmouth Harbour is located to the north and east.
- 7.6. The land at parcel U2 nominally falls from west to east, toward Portsmouth Harbour. Surface water runoff occurs by overland flow which discharges into Portsmouth Harbour.

8. Source-Pathway-Receptor Assessments

- 8.1. The museum premises is at an elevation of approximately 3m AOD and some parts of the premises on the eastern side are currently susceptible to tidal flooding.
- 8.2. The EA mapping indicates the site is in undefended flood zone 3. The undefended site is at a very low risk of fluvial flooding, but at a low to moderate risk of tidal flooding.
- 8.3. The EA mapping indicates the site is not at risk of reservoir flooding.
- 8.4. The EA mapping indicates the site is at a very low risk of surface water flooding
- 8.5. The SFRA mapping indicates no historical sewer flooding incidents on the site.
- 8.6. The SFRA mapping indicates the site is not at risk of groundwater flooding.
- 8.7. The critical flood source is tidal flooding and run-off within the site. The site surface water system will accord with the principles of CIRIA C753.
- 8.8. The new flood receptors of the development would be:
 - Holiday-let accommodation
 - Users of the holiday-let accommodation
- 8.9. The proposed development and existing site classifications to Table 2 (Paragraph 066 Reference ID: 7-066-20140306) are as follows:

• Existing commercial use	Less vulnerable
• Proposed holiday-let use	More vulnerable
- 8.10. Overall the site, in a defended state, is considered to be at a low flood risk.

9. Flood Probability

- 9.1. The EA flood zones shown on the outputs and included in the Appendix represents current best estimates of zone 2 and zone 3 flooding. It does not take account of potential climate change impacts. The flood zone definitions to Table 1 (065 Reference ID: 7-065-20140306) are as follows:

Zone 1	Low probability of flooding (<0.1% AEP)
Zone 2	Medium probability of tidal flooding (0.1%-0.5%AEP)
	Medium probability of fluvial flooding (0.1%-1% AEP)
Zone 3a	High probability of tidal flooding (>0.5% AEP)

Zone 3b High probability of fluvial flooding (>1% AEP)
Functional floodplain (>5% AEP probability of flooding)

The flood map does not differentiate between zones 3a and 3b.
Zone 3b is only considered appropriate for water-compatible development.
Zone 3a is additionally considered appropriate for less vulnerable uses.

- 9.2. Parcels M and U are in undefended flood zone 2. Parcel U2 is currently in undefended flood zone 3.

10. Climate Change

- 10.1. The proposed site is in flood zone 1. The new climate changes allowances for flood risk assessment GOV.UK 3 February 2017 update have been used. Climate changes values for the site are:
- Peak river flow: Table 1, South East basin, third epoch, central range +35%
 - Peak rainfall intensity: Table 2, third epoch, central range +20%
 - Sea level rise. Table 3, South East, epoch 4 to 2115_{AD} +1.17m over 2017
- 10.2. The SFRA map set 1D indicates the 2115_{AD} climate change extent for tidal flooding without coastal defences. However this tidal flood risk will be mitigated by the presence of maintained coastal defences SMP-unit 5a25 which advocates a Hold The Line policy (Refer to paragraph 4.3).
- 10.3. Surface water drainage strategy is discussed in section 11. The volumes and flows for this strategy have been derived in accordance with CIRIA C753 and include for climate change effects.

11. Detailed Development Proposals & Surface Water Strategy

- 11.1. Parcels M and U comprise existing buildings with existing surface water drainage systems which are to be retained. Surface water discharge strategy follows a pre-set SuDS hierarchy with tier 1 being infiltration. The London Clay geology and immediate proximity to tidal waters make a tier 1 solution for Parcel U2 impractical. A tier 2 strategy to discharge to surface water body (Portsmouth Harbour) will therefore be adopted.
- 11.2. Building U2 comprise approximately 100m² of roof. With respect to the managed adaptive approach discussed in Section 12 it will be prudent to allow for future 6 hour tidelock of the drainage system to parcel U2. Current M_{100 6hr} rainfall = 63mm. Allowing for +20% rainfall intensity and 10% urban creep a tidelock storage volume of some 9m³ will be required.
- 11.3. The surface water drainage system will be designed to accommodate a 1 in 100 year +20% climate change rainfall event + 10% urban creep. With respect to the Non-statutory Technical Standards for Sustainable Drainage Systems (NTS SuDS) the design accords with requirement S1. Standards S2-6 are not applicable due to discharge to tidal waters, and the design will accord with S7-9. Design and construction details will accord with Building Regulations and Sewers for Adoption, as appropriate, so according with S10-11 and S13-14. The design does not include pumping so S12 is not applicable.
- 11.4. Water butts should be installed to intercept roof water run-off. These will reduce the annual volume of surface water discharge but will not make any material contribution to regulation of critical run-off as these tend to be full during winter months as there is minimal demand for irrigation in these months.
- 11.5. In summary source control will be provided by:
- Provision of water butts as outlined in paragraph 11.4
- 11.6. The surface water strategy mimics the existing run-off regime. There will therefore be no adverse impact on flood flow rates outside the site.
- 11.7. The uses comprises generally low and very low pollution hazard levels (C753 Table 26.2) and do not require groundwater risk screening.

- 11.8. Simple index approach calculations are contained in Appendix C. These demonstrate that the proposed SUDS infrastructure can provide the mitigation necessary.
- 11.9. A schedule of O&M maintenance requirements for the SUDS infrastructure is also contained in Appendix C.

12. Sequential & Exceptions Tests

- 12.1. The redevelopment of Buildings M and U comprises a change of use of the existing buildings. NPPF 104 directs that minor development and changes of use should not be subject to the Sequential Test.
- 12.2. NPPF 104 also directs that minor development and changes of use should not be subject to the Exceptions Test.
- 12.3. Proposed building U2 is a new build proposal. Portsmouth Naval Base Property Trust are making this planning application as part of a wider site sustainability and regeneration strategy supported by Heritage Lottery Funding (HLF). The whole of the museum site is at very similar elevation albeit that at present this defines most of the site as FZ1 and some fringe areas as FZ 2 and 3. It is evident from SFRA map set 1D that potentially the majority of the museum site is within 2115_{AD} FZ3. In terms of the Sequential Test there is no reasonably available alternative site as the development must inherently be at the museum site.
- 12.4. NPPF 102 directs that the Exceptions Test must therefore be applied to proposed building U2. The proposed building is part of the ongoing regeneration and sustainability of the Explosion museum and important heritage assets at Priddys Hard. These form the wider sustainability developments to the community. Given the heritage status of the museum site, inclusive of various listed buildings and associated contexts the provision of sea defences needs to be considered carefully and the managed adaptive approach is recommended to inform longer term defence strategy. Raising land at the site of building U2 will not increase flood risk elsewhere as the nature of the flood risk is tidal and this is driven to a level by metrological circumstances and not driven by volumetric storage. At present the current access to the buildings is around or above 3.2m AOD (Inclusive of adoption of an appropriate FFL to building U2). Access and egress to the buildings in a design 0.5% AEP extreme tidal event would therefore be dry or of very limited <0.1m depth and thus deemed to be of sufficiently low hazard risk to FD2320. The proposed use as short term (approx. 2 days-1 week) holiday accommodation is subject to the direct control of the museum so bookings can be cancelled when required. The museum will subscribe to EA Flood warnings Direct (FWD). Tidal flooding is forecastable sufficiently far in advance of the event to enable booking cancellation or evacuation in accordance with a Flood Warning and Escape Plan (FWEP). The longer term strategy is discussed in paragraph 12.6.
- 12.5. NPPG ID 7-048-20140306 requires that future users of the change of use development will not be placed in danger from the hazards through its lifetime. The same managed adaptive approach applies to the change of use buildings. Initially, for up to a maximum of around 10 years, undefended 0.5% AEP tidal flood water depths would be of low hazard and advance bookings cancellation or evacuation through FWEP can be made from FWD warnings. The longer term strategy is discussed in paragraph 12.6.
- 12.6. In the longer term undefended 0.5% AEP tidal flood depths would increase through the effects of climate change and would if unmitigated increase the hazard exposure above the accepted safe levels defined in FD2320. The longer term strategy is to install a combination of waterside and/or internal flood walls to exclude the 0.5%AEP tidal flood. The walls may take the form of earth banks, plain walls, dwarf walls below railing alignments or masonry flower beds etc. There are a number of walls types already present within and adjacent the museum location and a selection of these are shown in the photographs in Appendix A. Due to the visual impact such infrastructure may be constructed in one or more vertical stages in response to future climate change. It is also likely that different sections of the wall would be constructed in different phases as sustainability and heritage development and repair works takes place around the wider site. In all cases the strategy would provide for a complete contiguous defence up to 0.5% AEP tidal flood levels at any time. Subscription to FWD and maintenance of a FWEP will be maintained through the lifetime of the development.

13. Flood Risk Management Measures

- 13.1. The source pathway receptor assessment is contained in Chapter 8.
- 13.2. Paragraph 8.7 identifies that tidal flooding and tidelock is the governing flood source. The management of the storage and conveyance of these volumes and flows is provided for by the surface water strategy set out in Chapter 11. The strategy accords with CIRIA C753 SuDS Manual.
- 13.3. The site will maintain subscription to FWD and develop and maintain a FWEP.
- 13.4. An appropriate FFL for building U2 will be agreed with the LPA, appropriate to the heritage context. It is recommended that if possible this should not be less than 3.37m AOD.
- 13.5. Prior to the construction of longer term sea defences (12.6 refers) flood resistant and resilient construction methods, materials and details shall be used for buildings M, U and U2 so far as the heritage circumstances may allow.
- 13.6. A flood wall alignment and detailing, appropriate to the heritage context will be developed for the site as part of a longer term managed adaptive approach. This will include an indication of the phasing or plan and vertical staging for the proposed defences.
- 13.7. The longer term managed adaptive approach will also need to consider surface water storage and discharge during future tidelock events.
- 13.8. The surface water strategy mimics the existing run-off regime. There will therefore be no adverse impact outside the site.

14. Off Site Impacts

- 14.1. The surface water strategy mimics the existing run-off regime. There will therefore be no adverse impact on outside the site.

15. Residual Risks

- 15.1. The proposed strategy for the development provides definitive measure for tidal flood events up to 1:200 year 2017AD in the short term and for provision of tidal defences as part of the managed adaptive approach for the longer term inclusive of climate change. The residual flood risk is therefore tidal events in excess of 1:200 year 2117AD
- 15.2. The SMP policy is for a Hold-the-Line policy for the lifetime of the SMP (100 years). The SMP makes no provision beyond the 100 year period.

Appendix A

Existing Layout & Proposed Site Layout



Aerial photograph of the site.



Building M west elevation



Building M North and East elevations



Building U2 site and north elevation Building U



Approach to buildings U and U2



Existing landward flood wall at Searle Drive



Existing wall within Explosion Museum with potential to act as internal flood wall



Existing seawall adjacent C Magazine building



Existing sea wall to Heritage Way immediately north of Explosion Museum



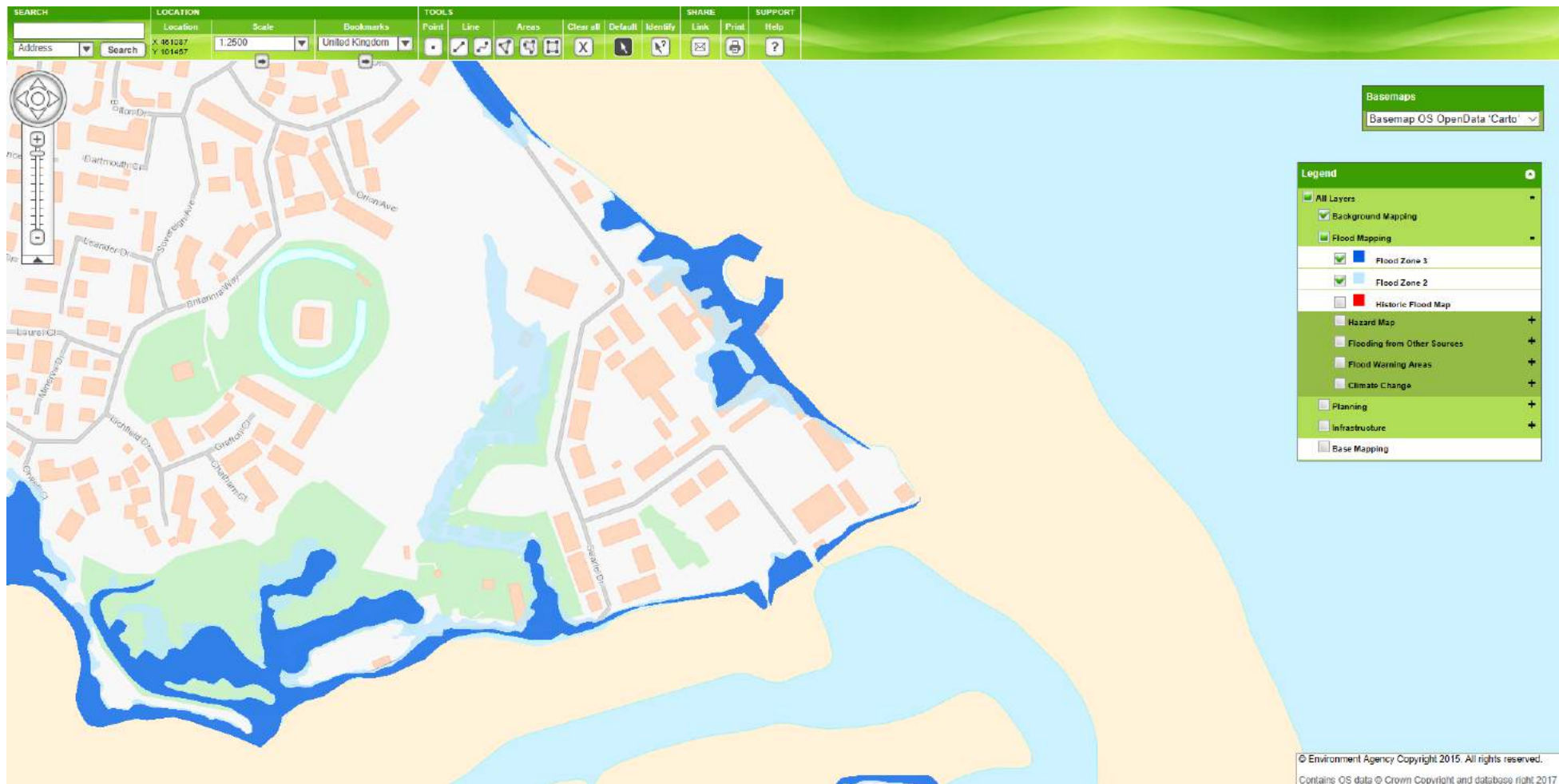
Existing sea wall on approach to shell filling rooms



Existing sea wall at shell filling rooms

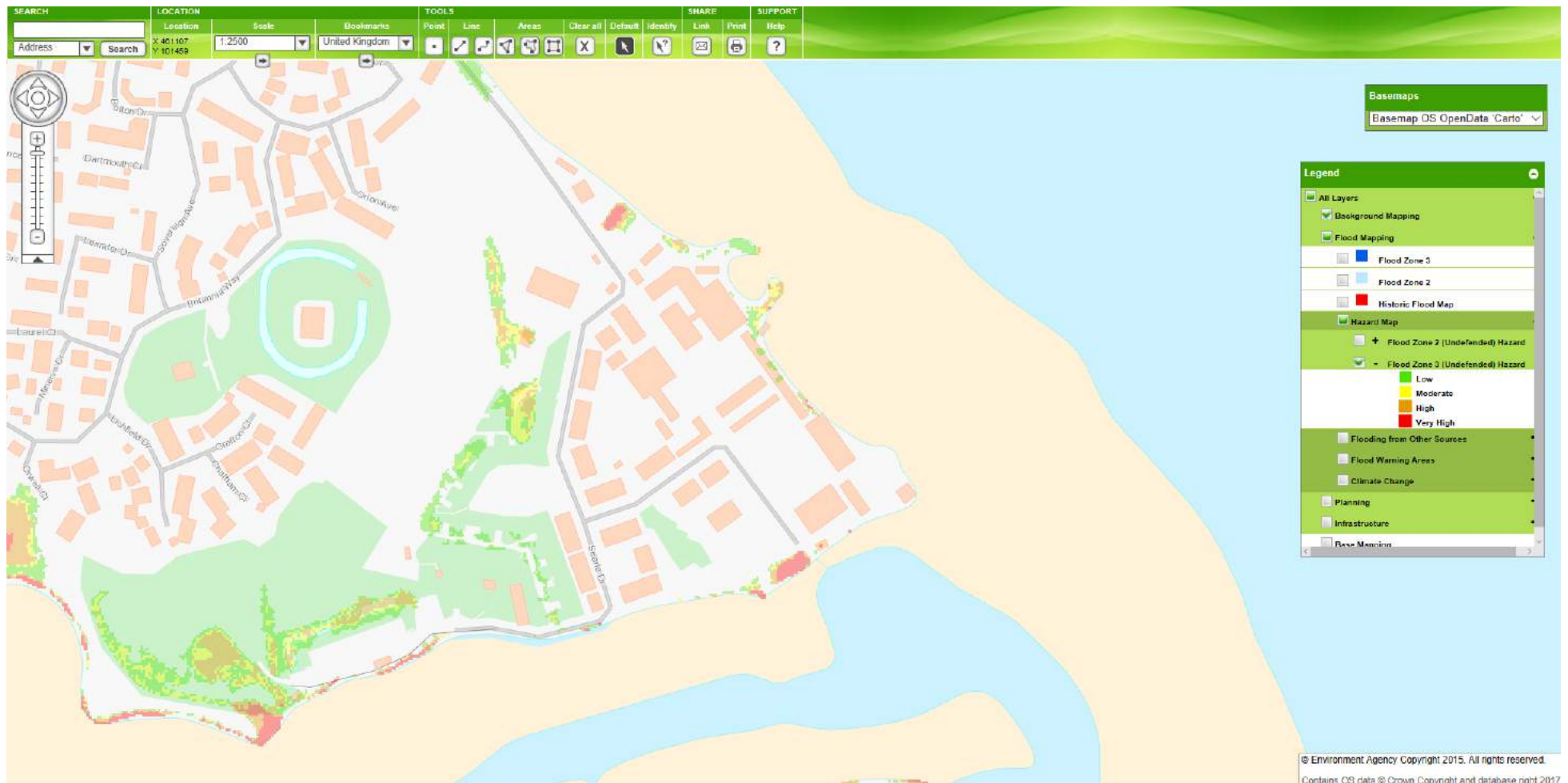
Appendix B

SFRA Map Data, EA Data & BGS Data



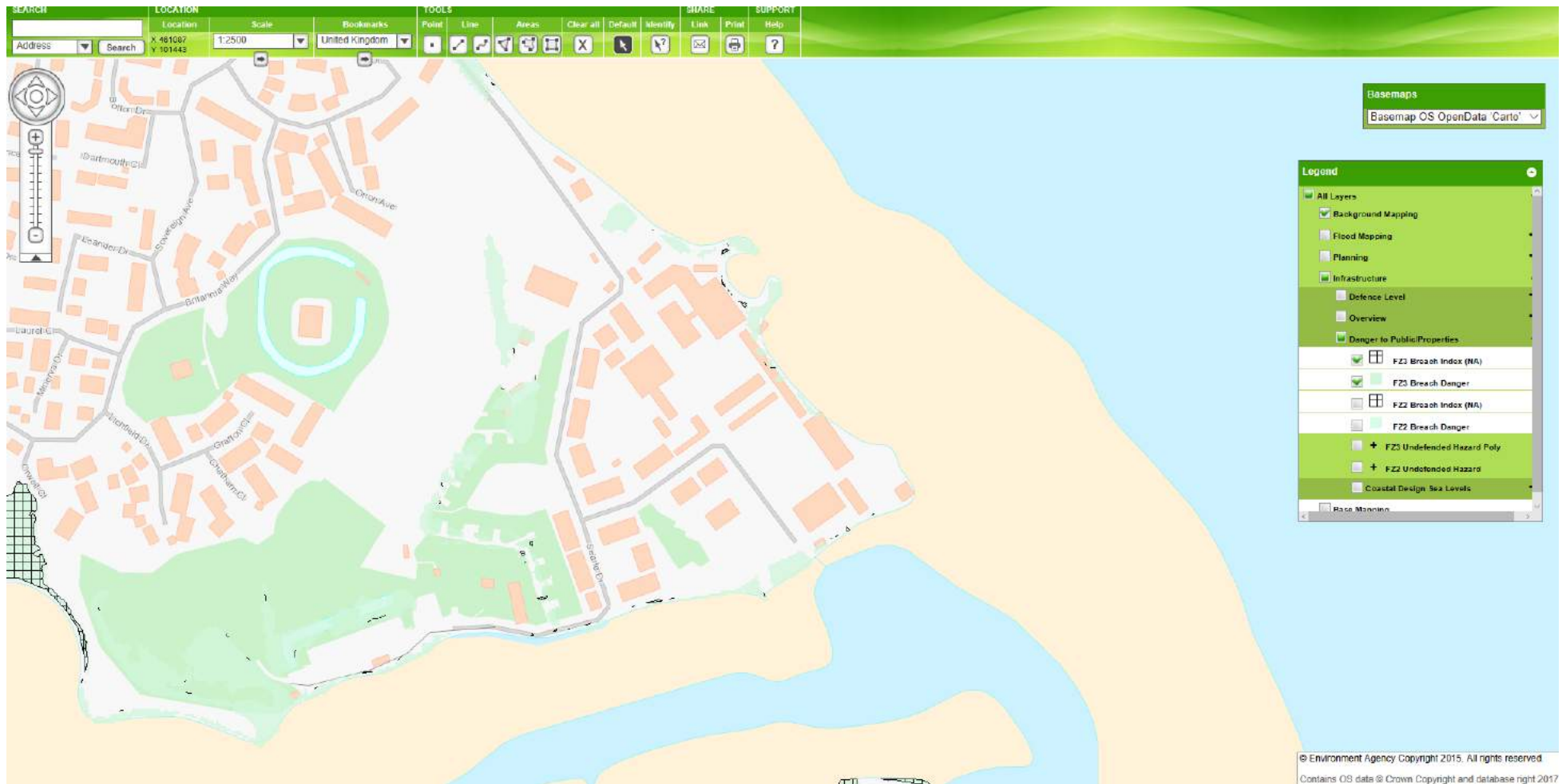
SFRA map set 1A

Flood Zones



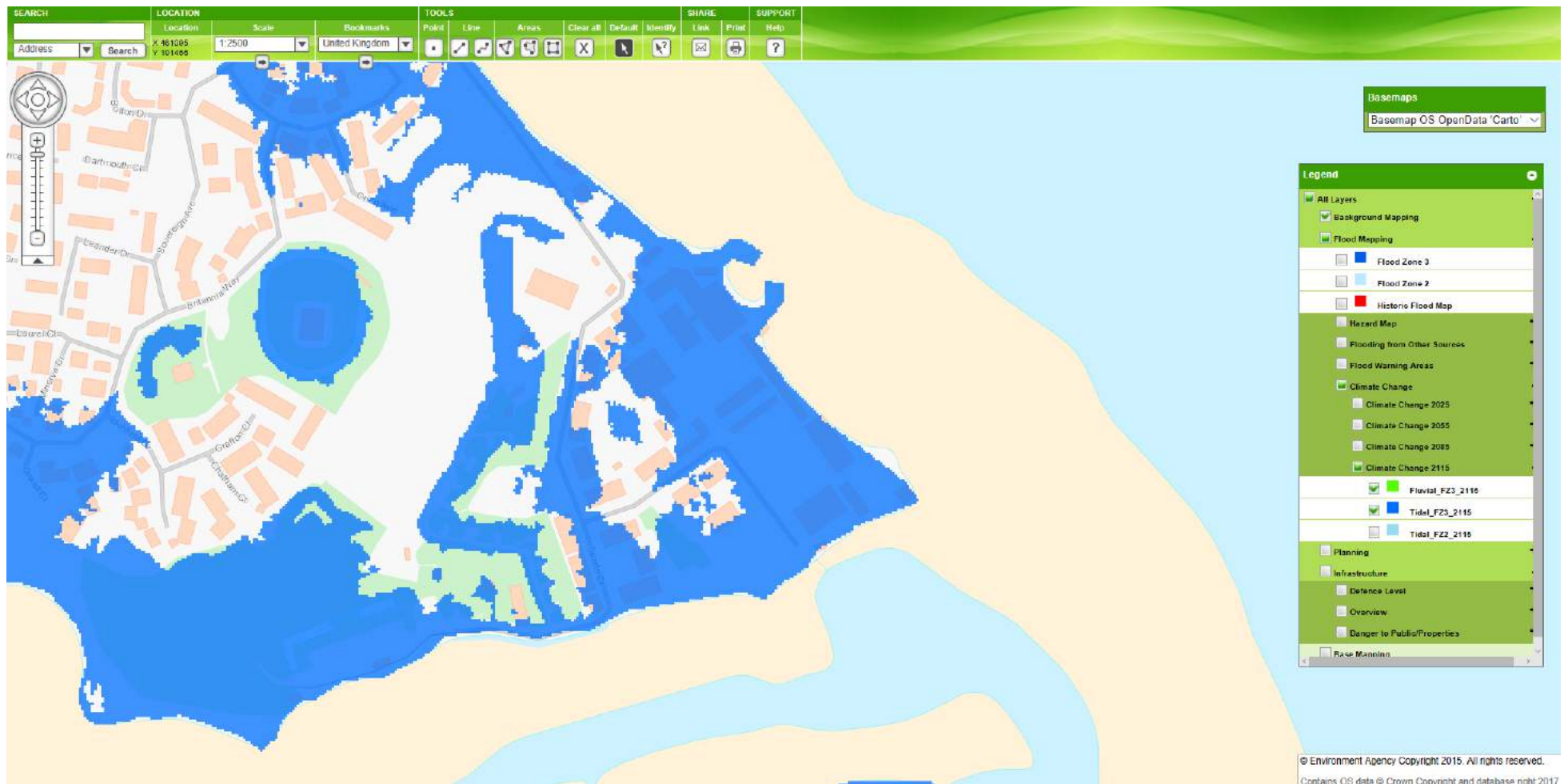
SFRA map set 1B

Flood Zone 3 (Undefended) hazard map



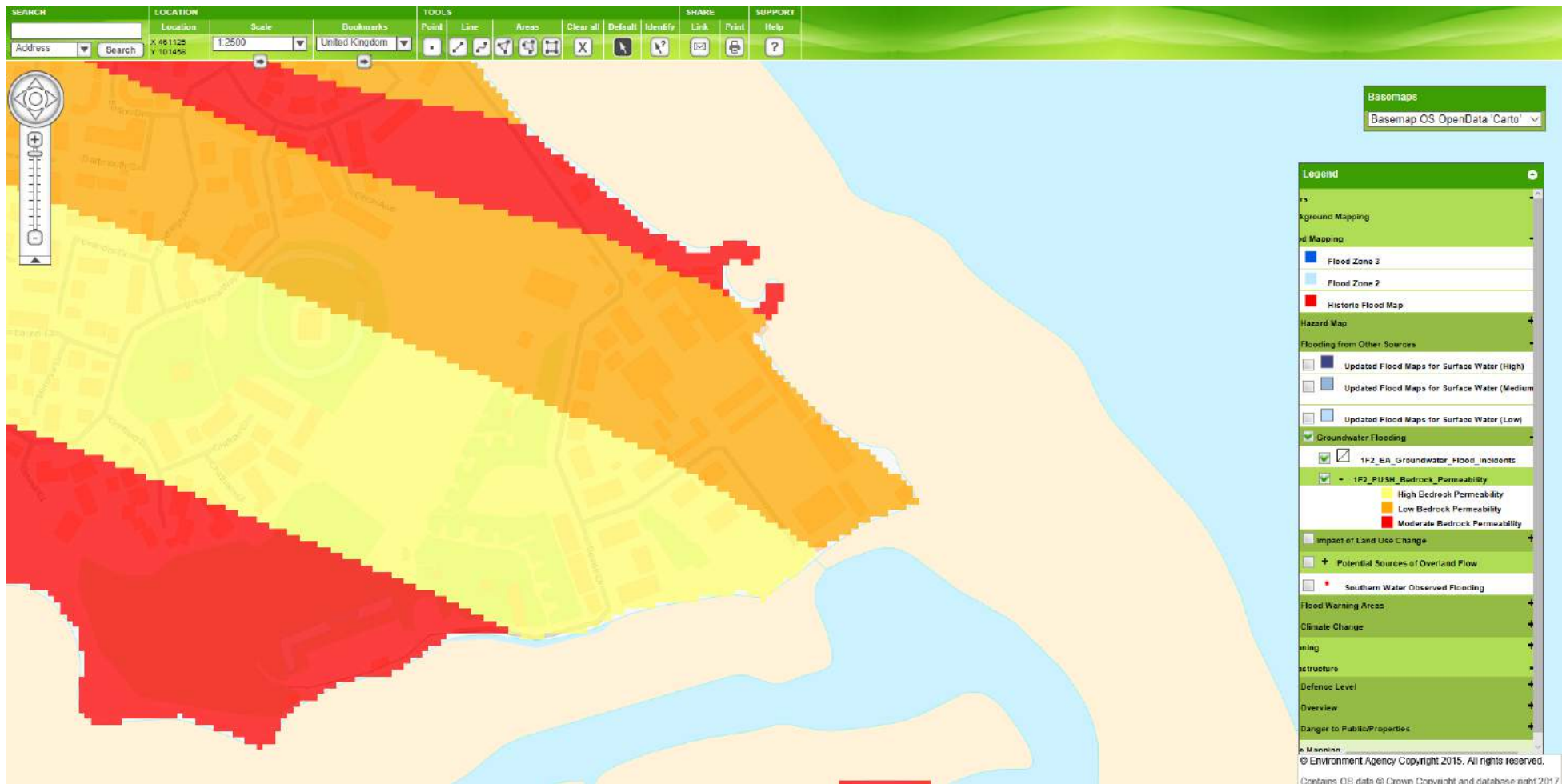
SFRA map set 1C

Danger from Breaching Flood Zone 3



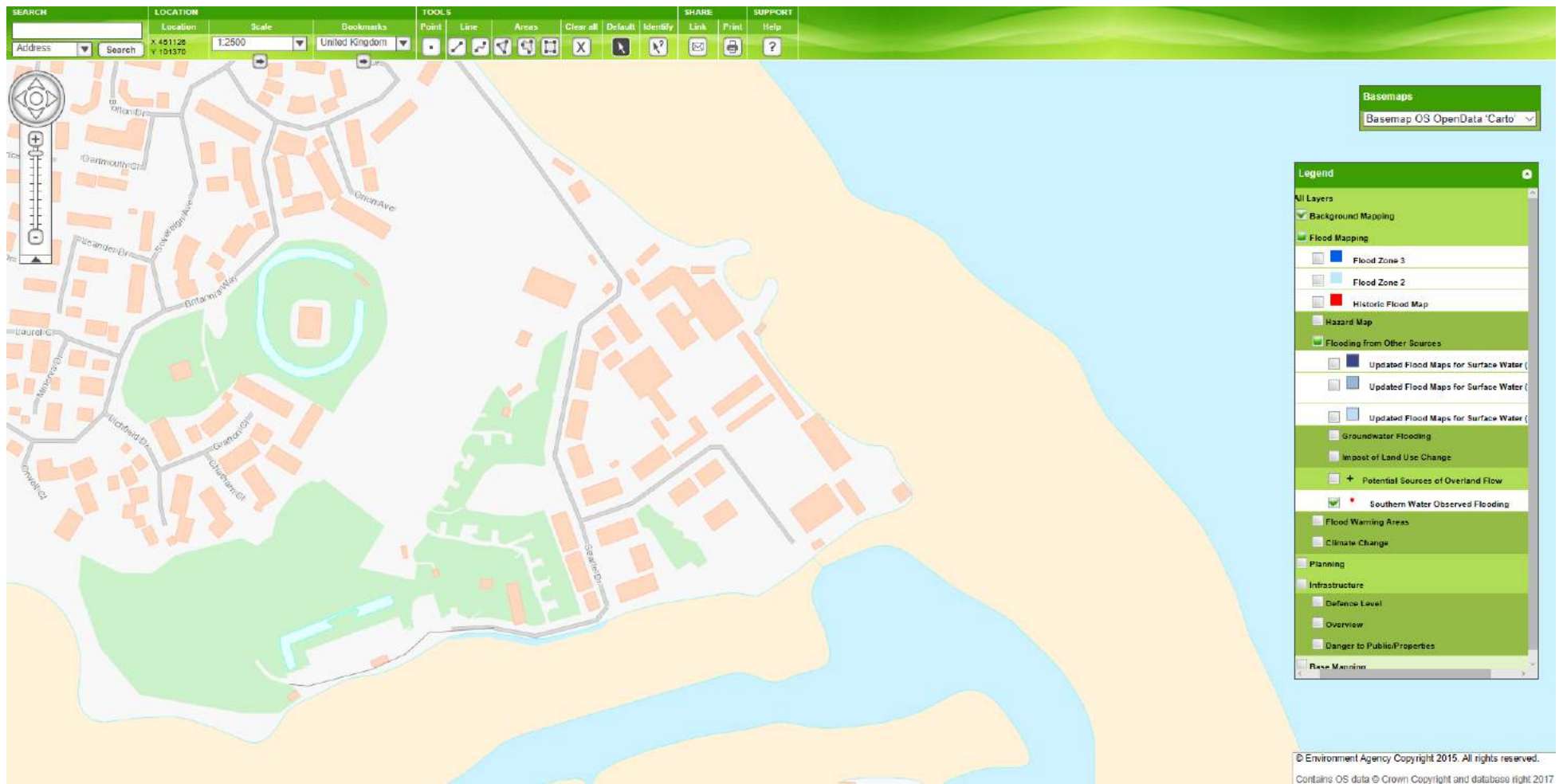
SFRA map set 1D

Climate Change 2115_{AD} Flood Zone 3



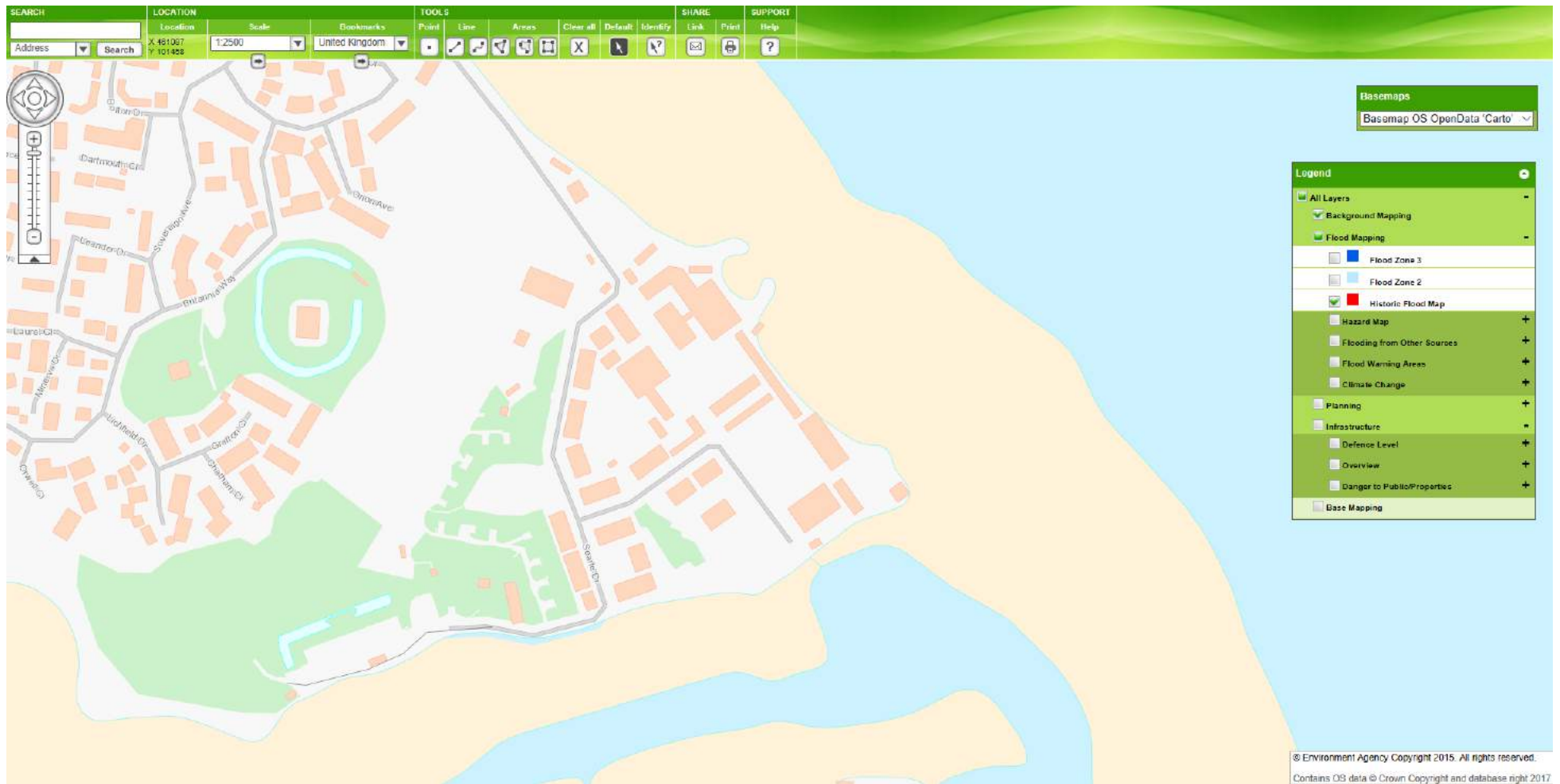
SFRA map set 1E

Groundwater Flooding & Bedrock Permeability



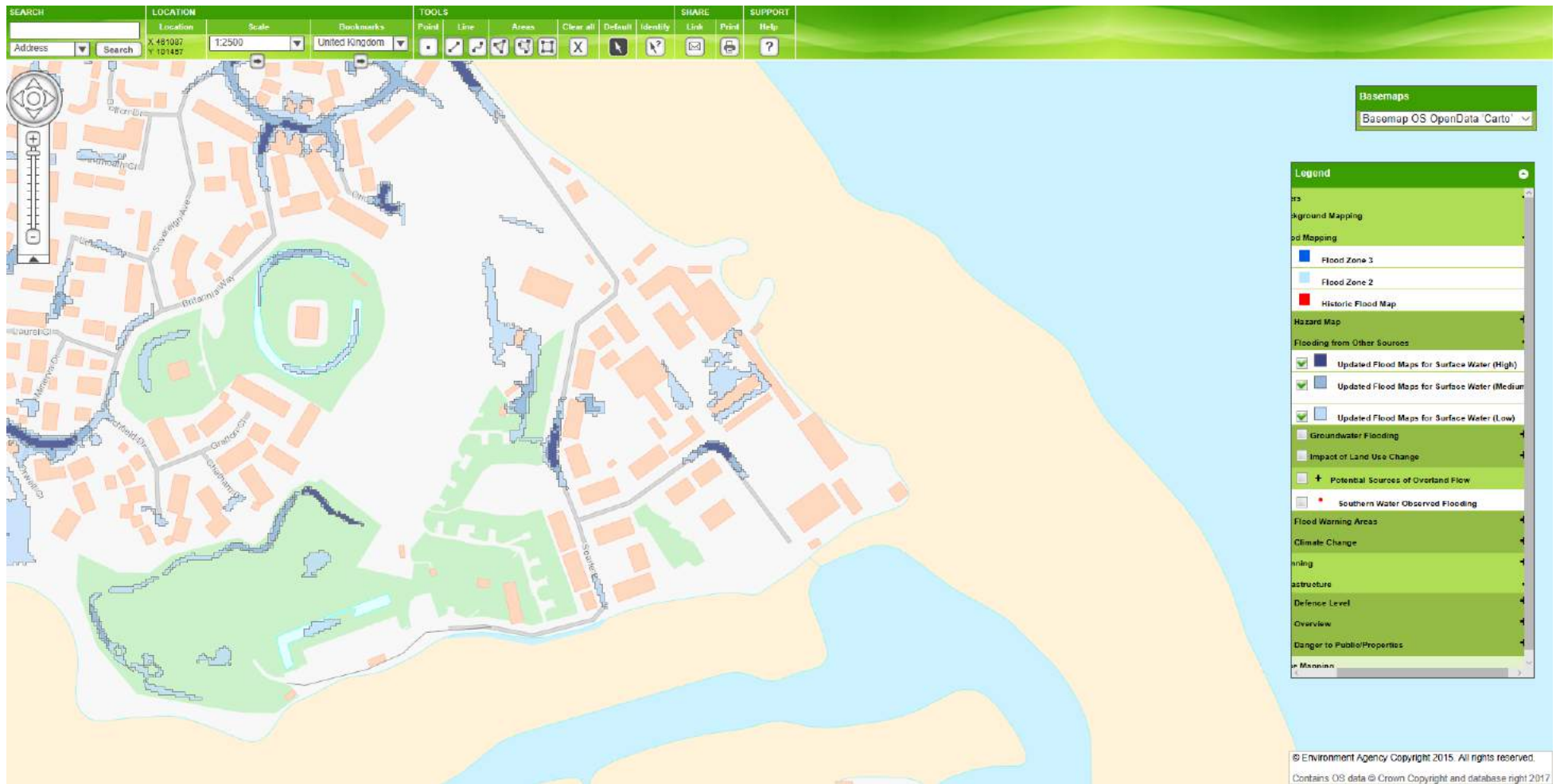
SFRA map set 1F

Observed Southern Water Sewer Flooding



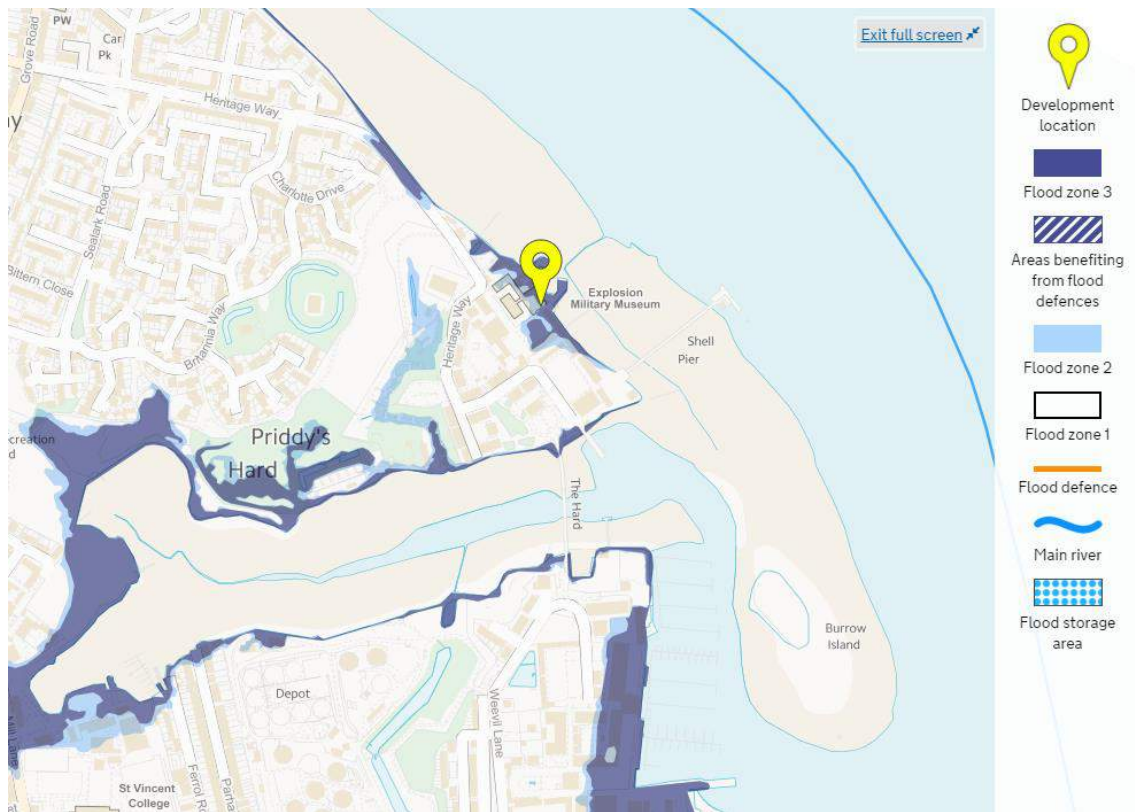
SFRA map set 1G

Historic Flood Map



SFRA map set 1H

Flood Map (Surface Water)

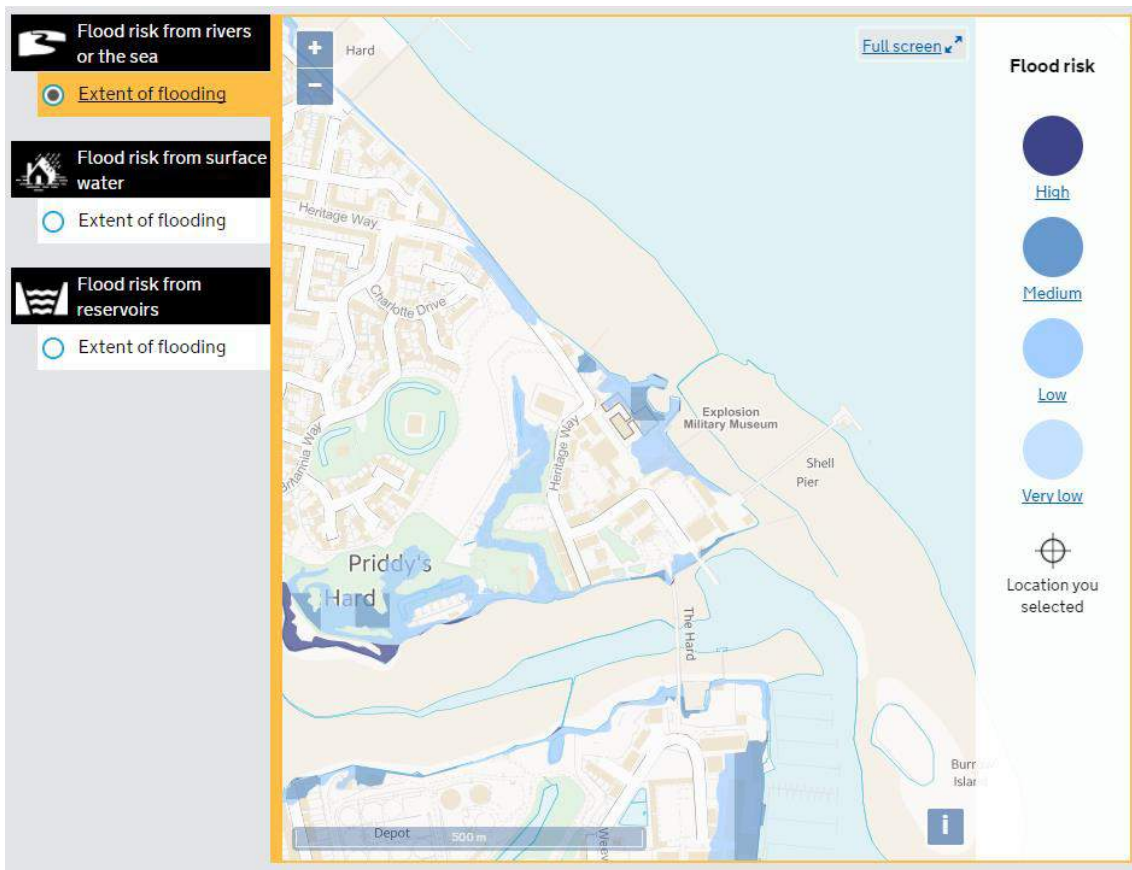


EA web map Local Main River Network & Flood Zones

Flood Zone definitions are set out in the National Planning Policy Guidance:

- * Flood Zone 1 - land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%)
- * Flood Zone 2 - land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% – 0.1%) in any year
- * Flood Zone 3 - land assessed as having 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

Note: These flood zones refer to the probability of river and sea flooding, ignoring the presence of defences.



EA web map Risk of Flooding from Rivers and the Sea

What does 'very low' mean?

Very low means that each year, this area has a chance of flooding of less than 1 in 1000 (0.1%).

What does 'low' mean?

Low means that each year, this area has a chance of flooding of between 1 in 1000 (0.1%) and 1 in 100 (1%).

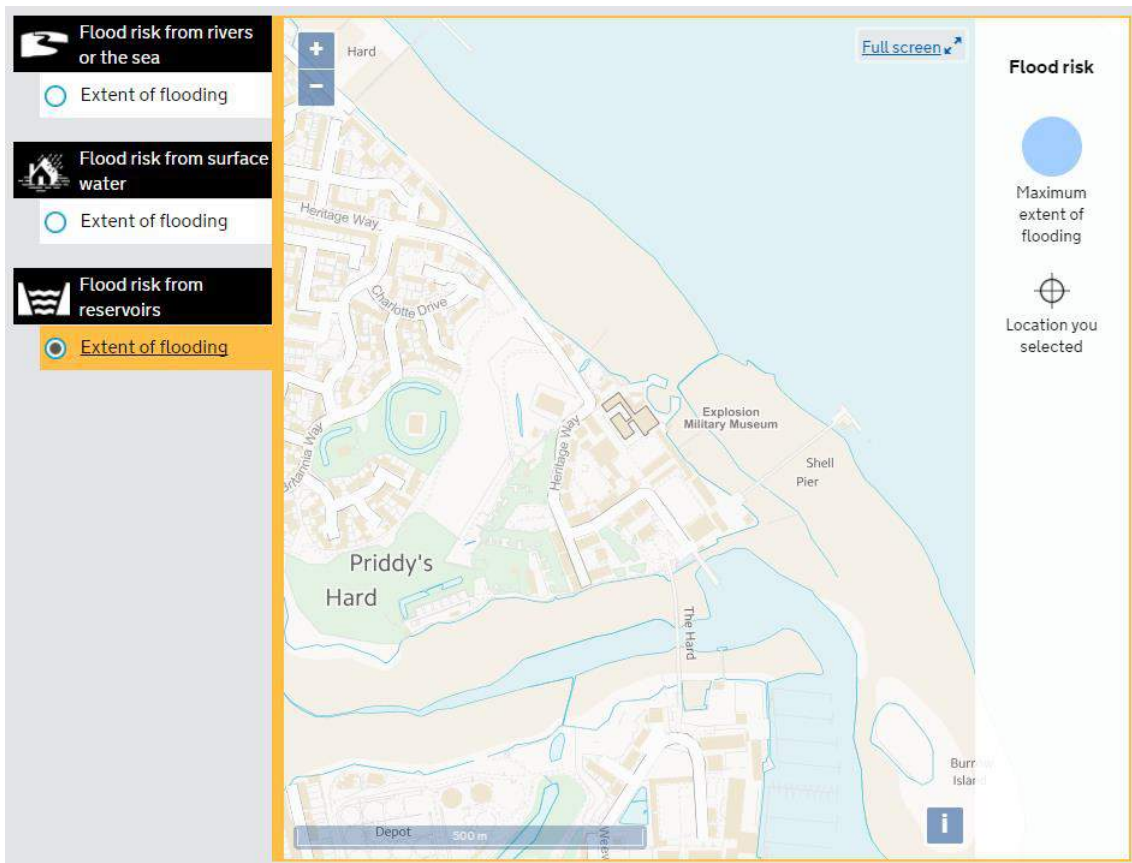
What does 'medium' mean?

Medium means that each year, this area has a chance of flooding of between 1 in 100 (1%) and 1 in 30 (3.3%).

What does 'high' mean?

High means that each year, this area has a chance of flooding of greater than 1 in 30 (3.3%).

This takes into account the effect of any flood defences that may be in this area. Flood defences reduce, but do not completely stop the chance of flooding as they can be overtopped or fail.



EA web map Risk of flooding from Reservoirs

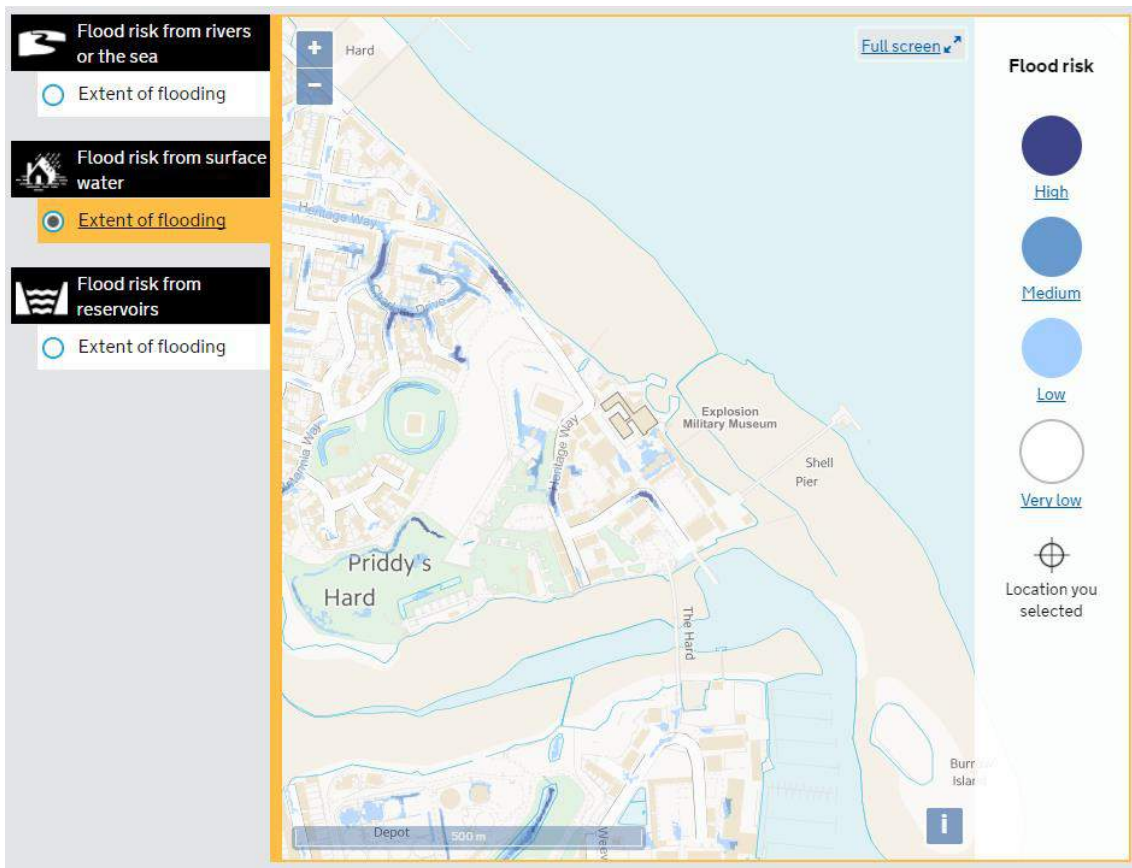
Where an extent is shown:

N/A for this site

Reservoir flooding is extremely unlikely to happen. There has been no loss of life in the UK from reservoir flooding since 1925. All large reservoirs must be inspected and supervised by reservoir panel engineers. As the enforcement authority for the Reservoirs Act 1975 in England, we ensure that reservoirs are inspected regularly and essential safety work is carried out.

However, in the unlikely event that a reservoir dam failed, a large volume of water would escape at once and flooding could happen with little or no warning. If you live or work in an area that could be affected, you should plan in advance what you would do in an emergency. You may need to evacuate immediately. Consider where you would go to safety, and be ready to follow the advice of emergency services.

To find out about local emergency plans, contact the local authority listed above. Be aware that they may not be able to give you any specific information immediately as developing reservoir emergency plans is a new responsibility.



EA web map Risk of flooding from surface water

What does 'very low' mean?

Very low means that each year, this area has a chance of flooding of less than 1 in 1000 (0.1%).

What does 'low' mean?

Low means that each year, this area has a chance of flooding of between 1 in 1000 (0.1%) and 1 in 100 (1%).

What does 'medium' mean?

Medium means that each year, this area has a chance of flooding of between 1 in 100 (1%) and 1 in 30 (3.3%).

What does 'high' mean?

High means that each year, this area has a chance of flooding of greater than 1 in 30 (3.3%).

This type of flooding can be difficult to predict, much more so than river or sea flooding as it is hard to forecast exactly where or how much rain will fall in any storm.

This is based on the best information we have available, such as ground levels and drainage.



Enter a postcode or place name:

Other topics for this area...

Groundwater

Go

Map legend

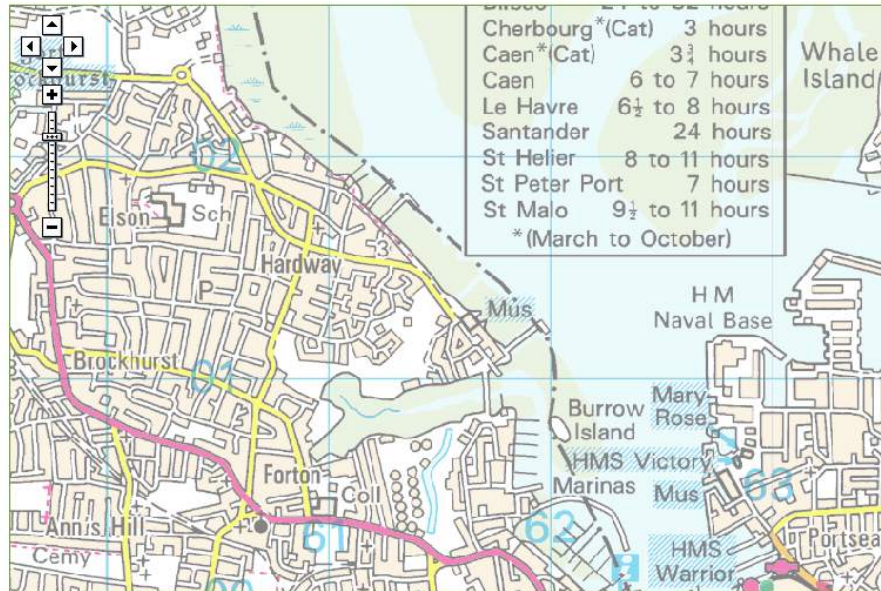
- Groundwater source protection zones [?](#)
- Inner zone (Zone 1)
- Inner zone - subsurface activity only (Zone 1c)
- Outer zone (Zone 2)
- Outer zone - subsurface activity only (Zone 2c)
- Total catchment (Zone 3)
- Total catchment - subsurface activity only (Zone 3c)
- Special interest (Zone 4)

BGS Aquifer Maps - Superficial Deposits Designation [?](#)

- Principal
- Secondary A
- Secondary B
- Secondary (undifferentiated)
- Unknown (lakes and landlip)

Map of PO12 4FL at scale 1:20,000

Other maps [?](#) Data search [?](#) Text only version [?](#)



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EA web map Groundwater Source Protection Zones



Enter a postcode or place name:

Other topics for this area...

Drinking Water Safeguard Zones

Go

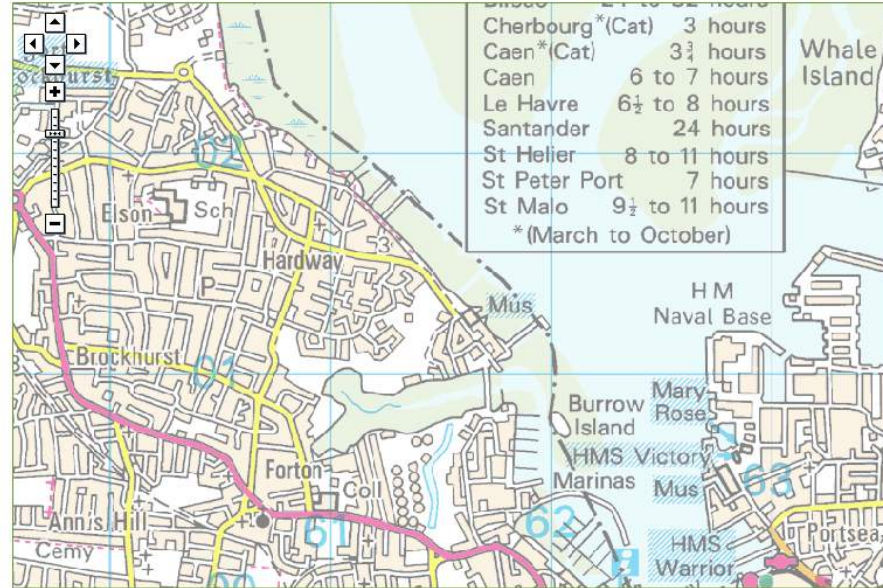
Drinking Water Safeguard Zones

Map legend

- Surface Water Safeguard Zones
- Safeguard Zones
- Groundwater Safeguard Zones
- Safeguard Zones
- Other national environmental organisations
- Natural Resources Wales Area of responsibility
- Scottish Environment Protection Agency Area of responsibility

Map of X: 461,557; Y: 101,354 at scale 1:20,000

Other maps Data search Text only version



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EA web map Drinking Water Protection Areas (Surface Water)



Enter a postcode or place name:

Other topics for this area...

Drinking Water Safeguard Zones

Go

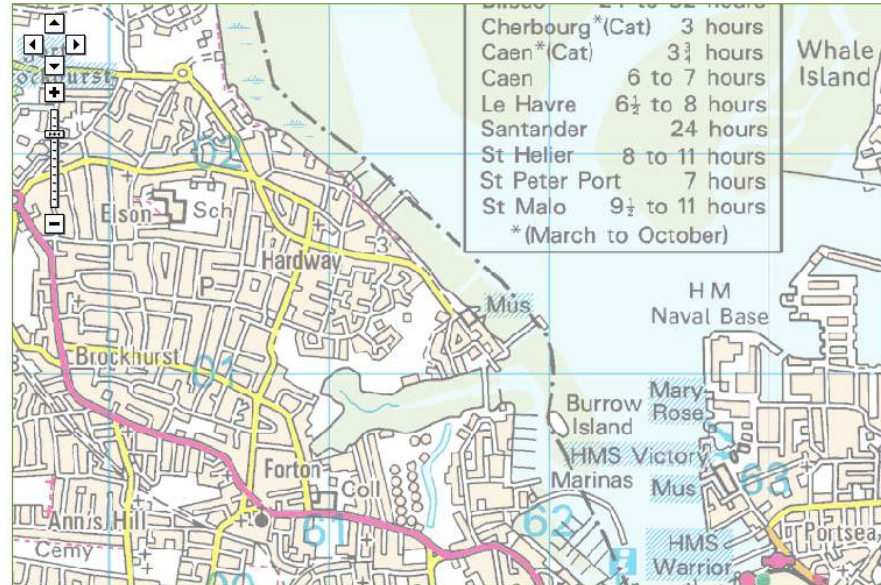
Drinking Water Safeguard Zones ▾

Map legend

- Surface Water Safeguard Zones
- Groundwater Safeguard Zones
- Other national environmental organisations
- Natural Resources Wales Area of responsibility
- Scottish Environment Protection Agency Area of responsibility

Map of X: 461,557; Y: 101,354 at scale 1:20,000

Other maps Data search Text only version



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EA web map Drinking Water Protection Areas (Groundwater)



British Geological Survey

NATURAL ENVIRONMENT RESEARCH COUNCIL



Surface Geology



3D Models



Borehole Scans



Earthquake Timeline

Surface Geology

- Superficial only
- Bedrock only
- Bedrock and Superficial

Visible geology:
1:50 000 scale

Geology Key

[More on digital geology.](#)

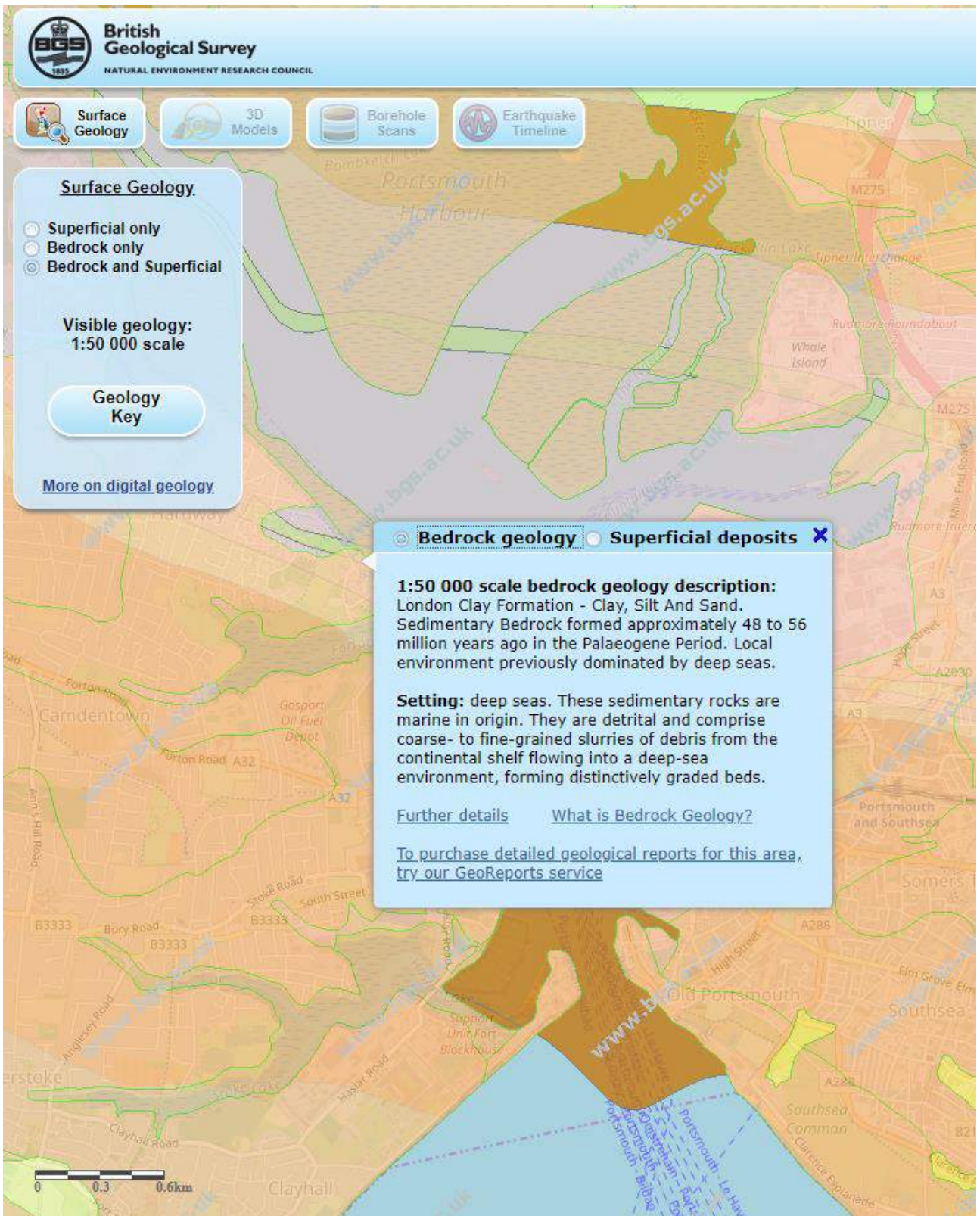
Bedrock geology Superficial deposits

1:50 000 scale bedrock geology description:
London Clay Formation - Clay, Silt And Sand.
Sedimentary Bedrock formed approximately 48 to 56 million years ago in the Palaeogene Period. Local environment previously dominated by deep seas.

Setting: deep seas. These sedimentary rocks are marine in origin. They are detrital and comprise coarse- to fine-grained slurries of debris from the continental shelf flowing into a deep-sea environment, forming distinctively graded beds.

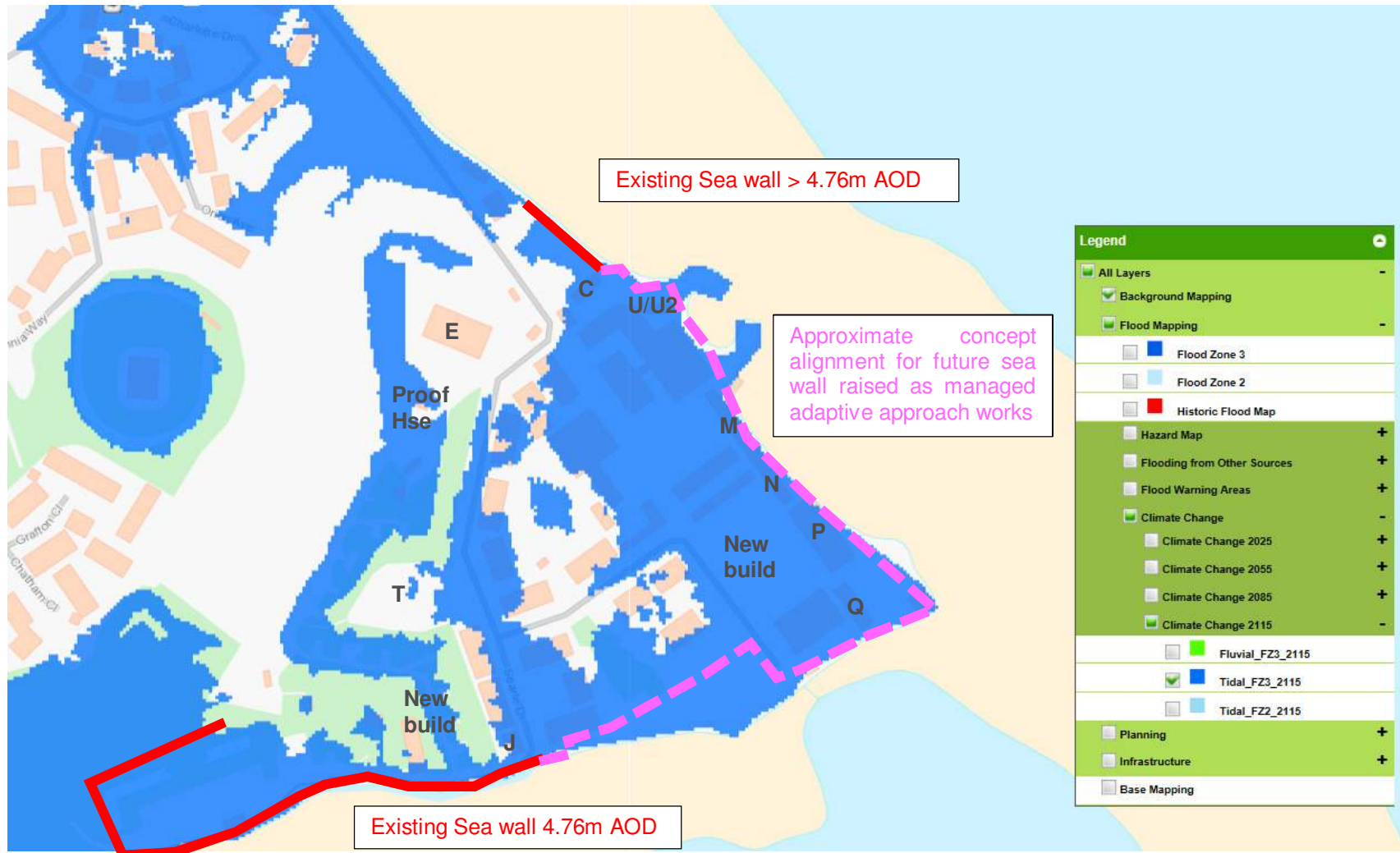
[Further details](#) [What is Bedrock Geology?](#)

[To purchase detailed geological reports for this area, try our GeoReports service](#)



Appendix C

Surface Water Assessment



2115_{AD} FZ3 with existing defences and Managed Adaptive Approach Concept



Existing seawall to Shell Filling Rooms west of the site



Existing defences at southern end of Searle Drive



Existing defences South of site to East of Heritage Way



Existing defences on Eastern side of site



Existing Seawall North of site



Existing Seawall North of Site

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Site Ref Explosion museum- U2

SuDS Water Quality Management CIRIA C753 Ch26

Simple Index Approach

Catchment

House roofs

Is discharge to: SPZ1? N Drinking Water Protection Zone? N
 Is site in close proximity to an area with sensitive environmental designation? N
 if so how close? _____ m
 Is an additional treatment component required due to sensitivity? N

Land Use

roofs-residential

Hazard

very low

TSS index	Metals index	HydroCar index
0.2	0.2	0.05

*2 residential roofs remove gross solids and sediments

Treatments

To surface water discharge Y

Component	TSS MIndex	Metals MIndex	HydroCa MIndex	factor
1 N/A	0	0	0	1.00
2 N/A	0	0	0	0.50
3 N/A	0	0	0	0.50
mitigation index basic OK	0	0	0	
X1 N/A	0	0	0	0.50
Enhanced mitigation index n/a	0	0	0	
Residual pollution index	0.2	0.2	0.05	

Land Use

roofs-residential

Hazard

very low

TSS index	Metals index	HydroCar index
0.2	0.2	0.05

residual

*2 residential roofs remove gross solids and sediments

Treatments

To groundwater discharge N

Infiltration surface	TSS MIndex	Metals MIndex	HydroCa MIndex	factor
1 N/A	0	0	0	1.00
Final residual pollution index	0.2	0.2	0.05	

Is a groundwater risk screening required? N

SUDS operation and maintenance - general

There are three categories on maintenance activities:

Regular maintenance consists of basic tasks done on a frequent and predictable schedule, including vegetation management, litter and debris removal, and inspections.

Occasional maintenance comprises tasks that are likely to be required periodically, but on a much less frequent and predictable basis than the routine tasks (sediment removal is an example). The table below summarises the likely maintenance activities required for each SUDS component and specific maintenance activities is given in the following sections.

Remedial maintenance comprises intermittent tasks that may be required to rectify faults associated with the system. Where remedial work is found to be necessary, it is likely to be due to site-specific characteristics or unforeseen events, and as such timings are difficult to predict. Remedial maintenance items can comprise items such as:

- inlet/outlet repairs
- erosion repairs
- reinstatement or realignment of edgings, barriers, rip-rap or other erosion control
- infiltration surface rehabilitation
- replacement of blocked filter fabrics
- construction stage sediment removal (although this activity should have been undertaken before the maintenance contract)
- system rehabilitation immediately following a pollution event.

O&M activity	SUDS component												
	Pond	Wetland	Detention basin	Infiltration basin	Soakaway	Infiltration trench	Filter trench	Modular storage	Pervios pavements	Swale/bioretention/greenroofs	Filter strip	Sand filter	Pre-treatment systems
Regular maintenance													
Inspection	■	■	■	■	■	■	■	■	■	■	■	■	■
Litter/debris removal	■	■	■	■	□	■	■	□	■	■	■	■	■
Grass cutting	■	■	■	■	□	■	■	□	□	■	■	□	□
Wee/invasive plant control	□	□	□	□		□	□		□	□	□	□	□
Shrub management	□	□	□	□					□	□	□		□
Shoreline vegetation management	■	■	□										□
Aquatic vegetation management	■	■	□										□
Occasional maintenance													
Sediment management *	■	■	■	■	■	■	■	■	■	■	■	■	■
Vegetation/plant replacement	□	□	□	□						□	□		□
Vacuum sweeping and brushing									■				
Remedial maintenance													
Structure rehabilitation/repair	□	□	□	□	□	□	□	□	□	□	□	□	□
Infiltration surface reconditioning				□	□	□	□		□	□	□	□	

■ will be required □ may be required * sediment to be collected upstream of the main device

GENERAL MAINTENANCE

Litter/debris removal

This is an integral part of SUDS maintenance and reduces the risks of inlet and outlet blockages, retains amenity value and minimises pollution risks. High litter removal frequencies may be required at high profile commercial/retail parks where aesthetics are a major driver.

Grass cutting

It is recommended that grass cutting be minimised around SUDS facilities, apart from swales and filter strips and structural embankments where a height of 100–150 mm is recommended to prevent the plants falling over, or “lodging”, when water flows across the surface. In general, allowing grass to grow tends to enhance water quality performance. Short grass around a wet system such as pond or wetland provides an ideal habitat for nuisance species such as geese; allowing the grass to grow is an effective means of discouraging them. Grass around wet pond or wetland systems should not be cut to the edge of the permanent water. Grass cutting is an activity undertaken primarily to enhance the perceived aesthetics of the facility. The frequency of cutting will tend to depend on surrounding land uses, and public requirements. Therefore, grass cutting should be done as infrequently as possible, recognising the aesthetic concerns of local residents. However, grass around inlet and outlet infrastructure should be trimmed closely to reduce risks to system performance. If a manicured, parkland effect is required, then cutting will need to be undertaken more regularly than for meadow type grass areas, which aim to maximise habitat and biodiversity potential.

Weed/invasive plant control

Weeds are generally defined as vegetation types that are unwanted in a particular area. For SUDS, weeds are often alien or invasive species, which do not enhance the technical performance or aesthetic value of the system, or non-native species and the spread of which is undesirable. In some places, weeding has to be done by hand to prevent the destruction of surrounding vegetation (hand weeding should generally be required only during the first year, ie during plant establishment). However, over grassed surfaces, mowing can be an effective management measure. The use of herbicides and pesticides should be prohibited since they cause water quality deterioration. The use of fertilisers should also be limited or prohibited to minimise nutrient loadings which are damaging to water bodies.

Shrub management

Shrubs tend to be densely planted and are likely to require weeding at the base, especially during the first year to ensure that they get enough water. Shrubs should be selected so they can grow to their maximum natural height without pruning.

Aquatic/shoreline vegetation management

Aquatic plant aftercare in the first 1–3 years may be required to ensure establishment of planted vegetation and control nuisance weeds/invasive plants. Once established, the build-up of dead vegetation from previous seasons should be removed at convenient intervals to reduce organic silt accumulation (eg every three years and at the end of landscape contract periods).

Emergent vegetation may need to be harvested every 5–10 years to maintain flood attenuation volumes, optimise water quality treatment potential and ensure fresh growth, although this is often not required. Care should be taken to avoid nesting birds during the breeding season and to avoid great crested newt and water vole habitats. The typical window for this activity is towards the end of the growing season (September and October). As vegetation matures, plant height may also become a safety issue in residential areas.

Where emergent vegetation is managed, up to 25 per cent can be removed by cutting at 100 mm above soil level using shearing action machinery. Up to 25 per cent of submerged vegetation can be cut and raked out at any one time, using approved rakes, grabs or other techniques, depending on whether clay or waterproof membranes are present. Aquatic vegetation arisings should be stacked close to the water's edge for 48 hours to de-water and allow wildlife to return to the SUDS feature. They should then be removed to wildlife piles, compost heaps or off site before decomposition, rotting or damage to existing vegetation can occur.

Algae removal may be undertaken for aesthetic purposes during the first 3–5 years of a pond/wetland's life. The growth of algae, which is considered by some to be visually intrusive, is encouraged by nutrients introduced into the water body. This situation should settle down once upstream construction activities are complete.

Management of green waste

Appropriate methods should be implemented to dispose of green waste, including

- The development of wildlife piles
- On- or off-site composting
- Disposal to landfill

REMEDIAL MAINTENANCE

Structure rehabilitation/repair

There will come a time with most SUDS techniques when a major overhaul of the system is required to remove clogged filters, geotextiles, gravel etc. This will typically be between 10 and 25 years, depending on the technique and factors such as the type of catchment and sediment load. For example the use of geotextiles close to the surface in pervious surfaces traps the majority of sediment in a relatively easily accessible location. Reconstruction of the surface layer and bedding layer is all that is required, rather than reconstruction of the whole pavement depth.

Major overhaul is most likely to be required on techniques that rely on filtration through soils or aggregates, such as sand filters and infiltration devices. Other SUDS techniques are unlikely to need major overhaul if routine maintenance is undertaken as required (for example ponds and wetlands).

Rehabilitation activities for each SUDS component are described on the following tables.

Infiltration surface rehabilitation

In the event that grassed surface permeability has reduced, there are a number of landscape techniques that can be used to open the surface to encourage infiltration. Such activities are not commonplace and are likely to be required only in circumstances where silt has not been effectively managed upstream.

1. Scarifying to remove “thatch”. Thatch is a tightly intermingled organic layer of dead and living shoots, stems and roots, developing between the zone of green vegetation and the soil surface. Scarifying with tractor-drawn or self-propelled equipment to a depth of at least 50 mm breaks up silt deposits, removes dead grass and other organic matter and relieves compaction of the soil surface.
2. Spiking or tining the soil, using aerating equipment to encourage water percolation. This is particularly effective if followed by top dressing with a medium to fine sand, and is best undertaken when the soil is moist. Spiking or tining with tractor drawn or self-propelled equipment penetrates and perforates soil layers to a depth of at least 100 mm (at 100 mm centres) and allows the entry of air, water, nutrients and top dressing materials.
3. As a last resort, it may be necessary to remove and replace the grass and topsoil by:
 - removing accumulated silt and (subject to a toxicity test) applying to land or dispose of to landfill
 - removing damaged turf which should be composted
 - cultivating remaining topsoil to required levels
 - re turfing (using turf of a quality and appearance to match existing) or reseeded (to BS 7370: Part 3, Clause 12.6 (BSI, 1991) using seed to match existing turf) area to required levels. It may be necessary to supply and fix fully biodegradable coir blanket to protect seeded soil. Turf and seeded areas should be top dressed with fine sieved topsoil to BS 3882 (BSI, 1994) to achieve final design levels. Watering will be required to promote successful germination and/or establishment.

Water butts operation and maintenance

Maintenance schedule	Required action	Frequency
Regular maintenance	Cleaning of tank, inlets, outlets, gutters, withdrawal devices and roof drain filters of silts and other debris..	Annually (or following poor performance).
Occasional maintenance	Replacement of any filters.	As required
Remedial actions	Repair of erosion damage, or damage to tank.	As required
Monitoring	Inspection of the tank for debris and sediment build up.	Annually (or following poor performance).
	Inspection of inlets, outlets and withdrawal devices.	Annually (or following poor performance).
	Inspection of areas receiving overflow, for evidence of erosion.	After extreme storms.
	Inspection of roof drain filters	Annually (or following poor performance).

Modular systems operation and maintenance

Maintenance schedule	Required action	Frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months, then six monthly
	Debris removal from catchment surface (where may cause risks to performance)	Monthly
	Where rainfall infiltrates into blocks from above, check surface of filter for blockage by silt, algae or other matter. Remove and replace surface infiltration medium as necessary.	Monthly (and after large storms)
	Remove sediment from pre-treatment structures	Annually, or as required
Occasional maintenance	-	-
Remedial actions	Repair/rehabilitation of inlets, outlet , overflows and vents	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually and after large storms

Appendix D

Conditions & Limitations

OPUS
ENGINEER'S INSPECTION
CONDITIONS AND LIMITATIONS

1. The report is a record of a visual inspection carried out by, or under the direction of a Chartered Structural Engineer and must not be misinterpreted as a Structural Survey such as would be carried out by a Chartered Surveyor. The report is not a Valuation Survey.
2. The inspection is strictly limited to the items requested and these will be detailed in Clause 1 of the report. No consideration will be given to any other aspects or parts of the building.
3. The report is confidential to the Client(s) stated in Clause 1 and has been prepared to their instructions for their own purposes only and it is not permitted to disclose this report to any other parties (except the Clients own Solicitors, Surveyors, Building Societies or Estate Agents) without the prior consent of Opus.
4. The copyright of this report remains the property of Opus.
5. No liability for the contents of this report is accepted to any parties other than the Client(s) stated in Clause 1.1. No parties other than the client stated in Clause 1.1 should rely upon this report.
6. Unless specifically stated otherwise:-
 - a) Trial holes will not be excavated prior to the preparation of the report and the depth and construction of the foundations and type of sub-soil will not be inspected.
 - b) All external observations will be carried out by eye from the ground level only. Internal inspection is made within the limits of ready accessibility and it is not normal practice to lift floor coverings or floor boards, remove fixtures, panels or plaster, or move heavy items of furniture or bulky goods or materials.
 - c) No inspection will be made of any roof voids, floor joists, wall cavities, drainage pipework or any other hidden or inaccessible parts.
 - d) No timbers will be checked for damp, rot, infestation by wood-boring insects or other defects.
 - e) It should not be construed that any parts of the construction comply with the requirements of the Building Regulations Act or standard practice either current or as current at the time of original construction. No enquiries to any Authorities will be made.
 - f) No testing or enquiries into the presence of or susceptibility to pollution, contamination, radiation, methane, radon or other gases or hazardous substances has been carried out.
7. Unless specifically stated otherwise in the report, any recommendations for works given in the report are outline only and are to be confirmed or modified as appropriate at detailed design stage.
8. Where trial holes are specifically included in our instructions the condition of the footing and the founding soil relates only to the point of excavation and does not necessarily confirm a continuation of the same conditions throughout the non-inspected areas of the structure. Whilst such trial pits will usually provide a reasonable indication as to the general state of the foundations and ground conditions, these cannot be determined with complete certainty.
9. Under the Construction (Design & Management) Regulations latest edition, the Client has obligations for ensuring Health and Safety arising from any construction work. If it is proposed to proceed with construction work based upon information or recommendations contained in this report, these regulations probably apply. Further details of any issues arising from our report or the Clients obligations generally are available on request.
10. Unless dealt with more specifically above the Association of Consulting Engineers Conditions of Engagement Short Form Agreement 2002 apply.



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