8. Conclusion

8.1 Ambiental Technical Solutions Limited has been appointed by GBA Designs to undertake a National Planning Policy Framework (NPPF) compliant Flood Risk Assessment (FRA) for the proposed development at Phoenix House, Aylesford, Kent, ME20 7AU.

8.2 The proposed development is for the construction of 12 new residential dwellings at the site. Of this, 9 are anticipated to be market price houses, while 3 will be affordable housing units.

8.3 With reference to the NPPF and the Environment Agency (EA) standing advice on development and flood risk, as well as the low detail, national-scale flood mapping created on behalf of the EA, the proposed development is located within Flood Zone 3 (high risk). The proposed development is considered to be a "More Vulnerable" development under the NPPF.

8.4 With focus on the potential main flood risk, the River Medway abuts the southern boundary of the site. With the site being located in Flood Zones 2 and 3, under the NPPF the development is required to provide a FRA in support of a planning application.

8.5 The EA have provided modelled flood levels for a defended, a defended overtopping, and undefended scenario. Analysis of the data provided by the EA indicates that the site does not currently benefit from the presence of any EA maintained formal defences. As such, undefended flood levels will be utilised for analysis.

8.6 Comparison between the 1:200 year flood level for 2115 (5.96mAOD) and the minimum topographic levels at the location of the proposed built footprints (5.45mAOD) indicate a maximum potential flood depth of 0.51m for the 1:200 year (2115) scenario.

8.7 It is therefore recommended that houses 1-6 are altered to include undercroft parking only at the ground floor, and the first floors/ sleeping accommodation of all 12 houses to be set to 6.56mAOD (600mm above 1:200 year (2115) flood level).

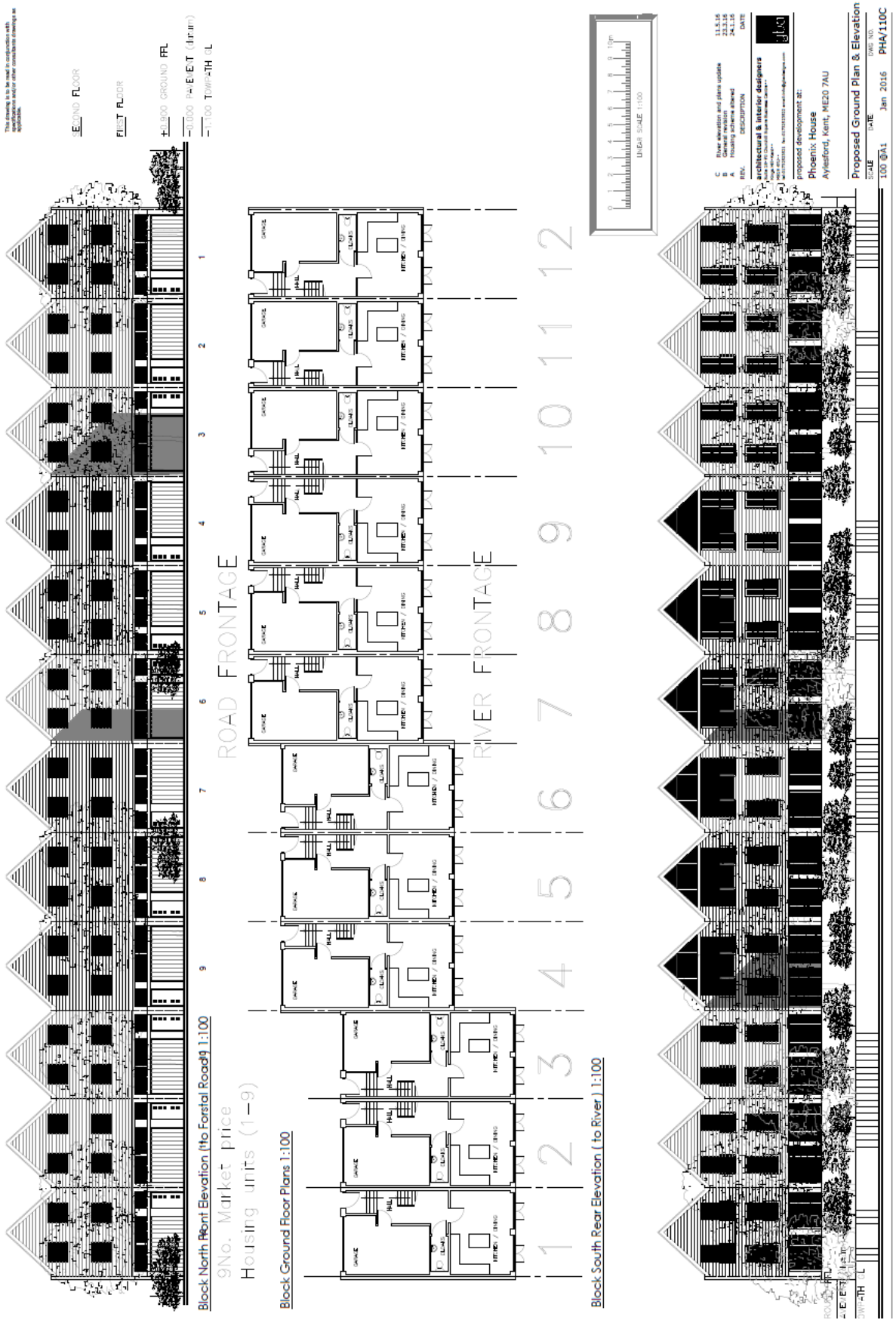
8.8 As such and given that:

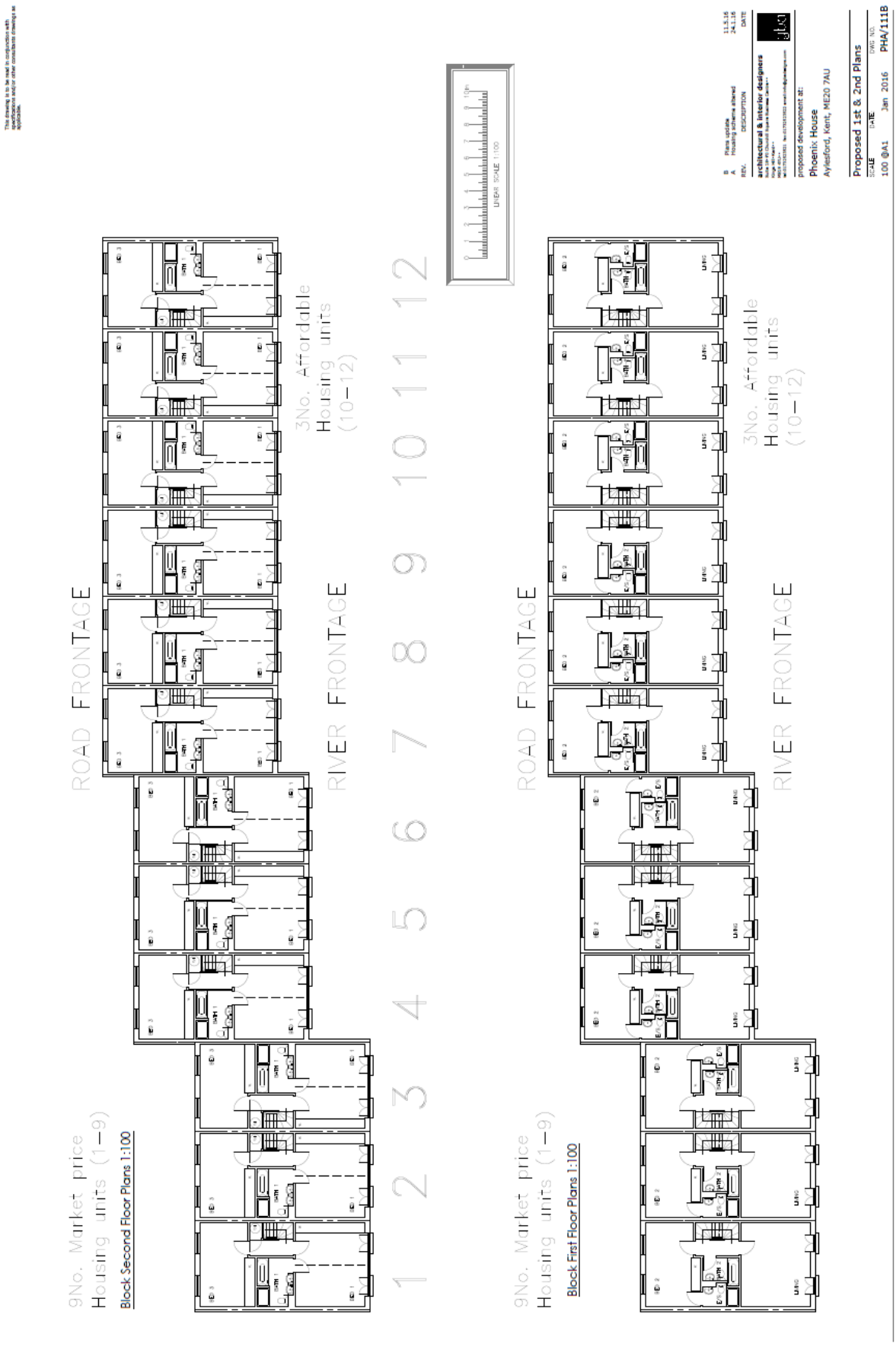
- The site lies within an area of tidal flood risk and therefore is not required to provide flood compensatory storage;
- It is recommended to have undercroft parking at the ground floor of houses 1-6;
- The first floor (sleeping accommodation) of all 12 dwellings to be setto 6.56mAOD (600mm above 1:200 year (2115) flood level);
- Given the nature of tidal flooding, prior evacuation can be sought;
- in terms of flood vulnerability, significant betterment can be achieved through the implementation of flood warning procedures as the site lies within an EA Flood Warning Service Area, and as such prior evacuation can be sought,

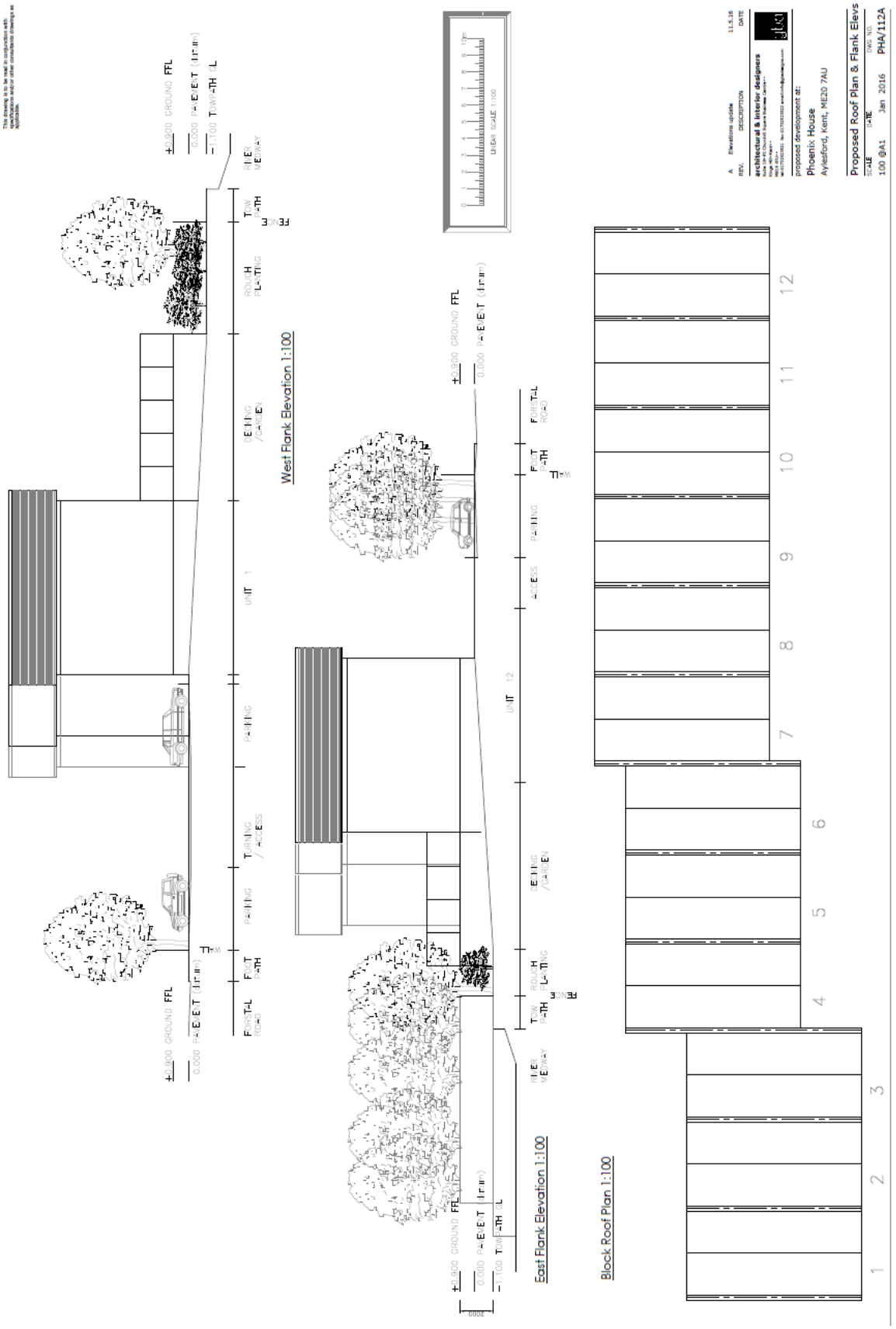
following the guidelines contained within NPPF, the proposed development type is considered to be suitable assuming appropriate mitigation (including adequate warning and evacuation procedures) can be maintained for its lifetime.

Dr. J. B. Butler
B.Sc., M.Phil., PhD.
Ambiental Technical Solutions Ltd. January 2017

Appendix A – Development Plans







Appendix B – Supporting Information

Environment Agency

Product 4 (Detailed Flood Risk) for: Phoenix House ,Aylesford, Kent, ME20 7AU
Requested by: Thea Powell, Abiental.
Reference: KSL 32689 SD
Date: 21/12/2016

Contents

The information provided is based on the best data available as of the date of this letter.

You may feel it is appropriate to contact our office at regular intervals, to check whether any amendments/ improvements have been made to the data for this location. Should you re-contact us after a period of time, please quote the above reference in order to help us deal with your query.

This information is provided subject to the enclosed notice which you should read.

Orchard House, Endeavour Park, London Road, Addington, West Malling, Kent, ME19 5SH.
Email: kslenquiries@environment-agency.gov.uk

Flood Map Confirmation

The Flood Map:

Our Flood Map shows the natural floodplain for areas at risk from river and tidal flooding. The floodplain is specifically mapped ignoring the presence and effect of defences. Although flood defences reduce the risk of flooding they cannot completely remove that risk as they may be over topped or breached during a flood event.

The Flood Map indicates areas with a 1% (0.5% in tidal areas), Annual Exceedance Probability (AEP) - the probability of a flood of a particular magnitude, or greater, occurring in any given year, and a 0.1% AEP of flooding from rivers and/or the sea in any given year. The map also shows the location of some flood defences and the areas that benefit from them.

The Flood Map is intended to act as a guide to indicate the potential risk of flooding. When producing it we use the best data available to us at the time, taking into account historic flooding and local knowledge. The Flood Map is updated on a quarterly basis to account for any amendments required. These amendments are then displayed on the internet at www.gov.uk/prepare-for-a-flood.

At this Site:

The Flood Map shows that this site lies within the outline of the 0.5% chance of flooding in any given year from the sea.

Enclosed is an extract of our Flood Map which shows this information for your area.

Method of production

The Flood Map at this location has been derived using detailed tidal modelling of the North Kent Coast, completed in August 2013.

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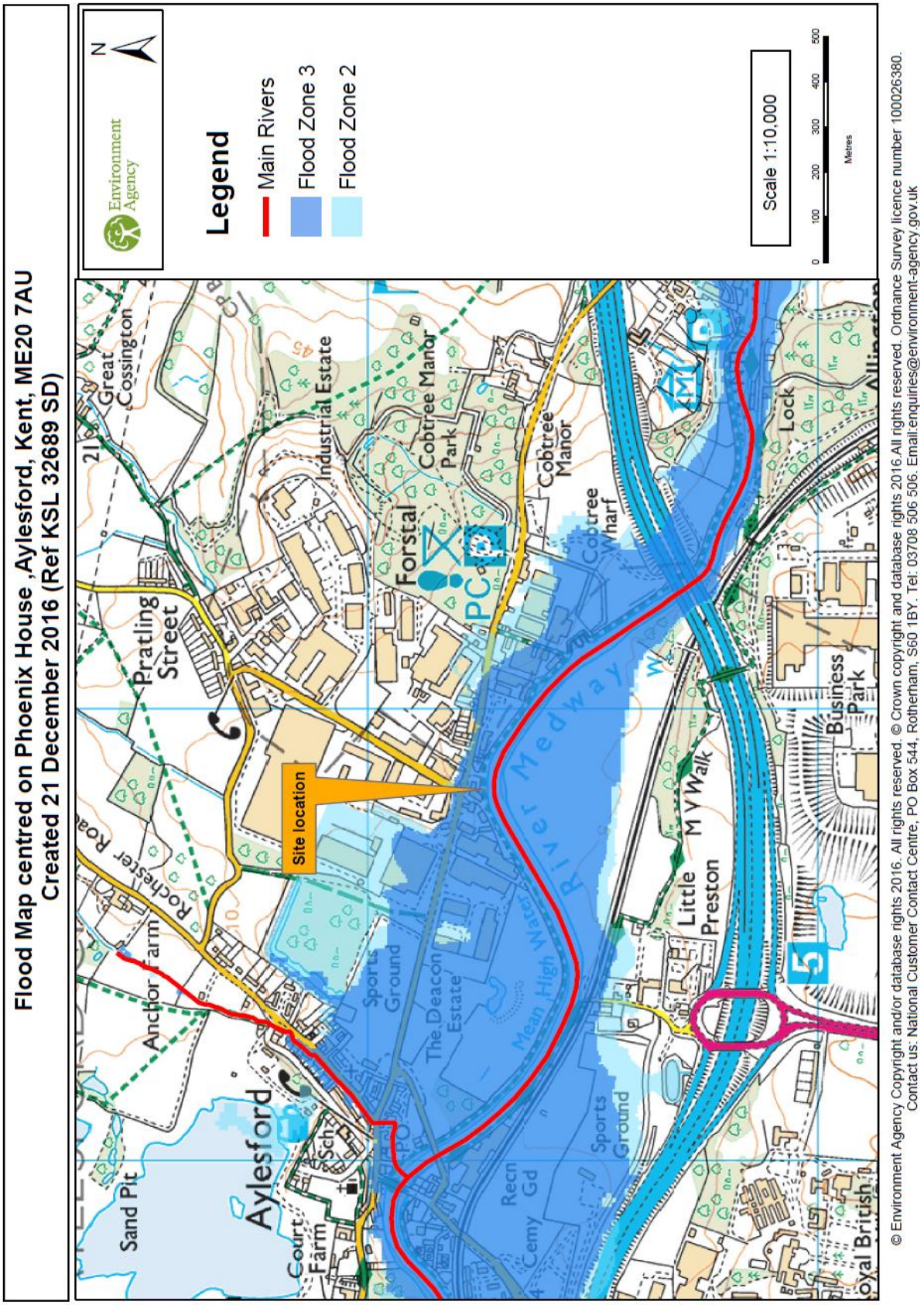

Environment Agency

Model Output Data

You have requested flood levels for various return periods at this location.

The modelled flood levels for the closest most appropriate model grid cells, any additional information you may need to know about the modelling from which they are derived and/or any specific use or health warning for their use are set out below.

Using a 2D TuFLOW model the floodplain has been represented as a grid. The flood water levels have been calculated for each grid cell.

A map showing the location of the points from which the data is taken is enclosed. Please note you should read the notice enclosed for your specific use rights.

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Environment Agency

Table 1: Defended Modelled Tidal Flood levels for Annual Exceedance Probability shown in mAOD (Still Water)

Modelled Node Id	National Grid Reference		Defended Scenario - Still Water					
	Eastings	Northings	0.1% AEP (2012)	0.5% AEP (2115)	0.5% AEP (2070)	0.5% AEP (2012)	1.3% AEP (2012)	5% AEP (2012)
1	573736	158712	5.450	5.902	5.481	5.194	5.050	4.908
2	573749	158719	5.453	5.904	5.485	5.186	5.047	4.911
3	573761	158726	5.458	5.907	5.490	5.195	5.054	4.919
4	573773	158730	5.461	5.908	5.493	5.203	5.061	4.927
5	573785	158734	5.462	5.909	5.495	5.208	5.064	4.927
6	573783	158742	5.463	5.909	5.496	5.210	5.065	4.928
7	573795	158734	5.463	5.909	5.496	5.210	5.065	4.927
8	573795	158748	5.465	5.909	5.497	5.213	5.060	4.929
9	573802	158758	5.465	5.909	5.497	5.212	0.000	0.000
10	573808	158769	0.000	5.909	0.000	0.000	0.000	0.000
11	573813	158777	0.000	5.910	0.000	0.000	0.000	0.000
12	573825	158773	0.000	5.910	0.000	0.000	0.000	0.000
13	573818	158760	0.000	5.909	0.000	0.000	0.000	0.000
14	573812	158749	0.000	5.909	0.000	0.000	0.000	0.000
15	573810	158738	5.462	5.909	5.495	5.209	5.063	4.924
16	573828	158740	5.463	5.909	5.496	5.208	5.062	4.918
17	573832	158752	0.000	5.909	0.000	0.000	0.000	0.000
18	573838	158769	5.466	5.910	5.500	0.000	0.000	0.000
19	573850	158765	5.466	5.910	5.499	0.000	0.000	0.000
20	573862	158761	5.465	5.910	5.498	5.214	0.000	0.000
21	573845	158752	0.000	5.910	0.000	0.000	0.000	0.000
22	573861	158747	5.465	5.910	5.498	5.214	5.071	4.933
23	573855	158738	5.465	5.910	5.497	5.213	5.069	4.928
24	573842	158740	5.464	5.909	5.497	5.211	5.066	4.924
25	573822	158785	5.451	5.910	5.501	0.000	0.000	0.000

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Environment Agency

Table 2: Defended Modelled Tidal Flood levels for Annual Exceedance Probability shown in mAOD (Wave Overtopping)

Modelled Node Id	National Grid Reference		Defended Scenario - Wave Overtopping				
	Eastings	Northings	0.1% AEP (2012)	0.5% AEP (2115)	0.5% AEP (2012)	1.3% AEP (2012)	5% AEP (2012)
1	573736	158712	5.450	5.902	5.194	5.051	4.907
2	573749	158719	5.453	5.904	5.186	5.047	4.913
3	573761	158726	5.457	5.907	5.195	5.053	4.921
4	573773	158730	5.460	5.908	5.203	5.061	4.926
5	573785	158734	5.462	5.909	5.208	5.064	4.927
6	573783	158742	5.463	5.909	5.210	5.065	4.928
7	573795	158734	5.463	5.909	5.210	5.065	4.927
8	573795	158748	5.465	5.909	5.213	5.067	4.928
9	573802	158758	5.464	5.909	5.212	0.000	0.000
10	573808	158769	0.000	5.909	0.000	0.000	0.000
11	573813	158777	0.000	5.909	0.000	0.000	0.000
12	573825	158773	0.000	5.909	0.000	0.000	0.000
13	573818	158760	0.000	5.909	0.000	0.000	0.000
14	573812	158749	0.000	5.909	0.000	0.000	0.000
15	573810	158738	5.462	5.909	5.209	5.064	4.923
16	573828	158740	5.462	5.909	5.208	5.062	4.917
17	573832	158752	0.000	5.909	0.000	0.000	0.000
18	573838	158769	5.466	5.910	0.000	0.000	0.000
19	573850	158765	5.466	5.910	0.000	0.000	0.000
20	573862	158761	5.465	5.910	5.215	0.000	0.000
21	573845	158752	0.000	5.909	0.000	0.000	0.000
22	573861	158747	5.465	5.910	5.214	5.072	4.934
23	573855	158738	5.464	5.910	5.213	5.069	4.928
24	573842	158740	5.463	5.909	5.211	5.067	4.924
25	573822	158785	5.454	5.910	0.000	0.000	0.000

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Environment Agency

Table 3: Undefended Modelled Tidal Flood levels for Annual Exceedance Probability shown in mAOD

Modelled Node Id	National Grid Reference		Undefended Scenario				
	Eastings	Northings	0.1% AEP (2012)	0.5% AEP (2115)	0.5% AEP (2070)	0.5% AEP (2012)	5% AEP (2012)
1	573736	158712	5.486	5.958	5.532	5.155	4.777
2	573749	158719	5.487	5.958	5.533	5.157	4.781
3	573761	158726	5.488	5.959	5.533	5.158	4.790
4	573773	158730	5.489	5.959	5.534	5.159	4.798
5	573785	158734	5.489	5.959	5.534	5.159	4.796
6	573783	158742	5.489	5.959	5.534	5.159	4.795
7	573795	158734	5.489	5.959	5.534	5.159	4.795
8	573795	158748	5.489	5.959	5.534	5.160	4.795
9	573802	158758	5.489	5.959	5.534	5.160	0.000
10	573808	158769	0.000	5.960	0.000	0.000	0.000
11	573813	158777	0.000	5.960	0.000	0.000	0.000
12	573825	158773	0.000	5.960	0.000	0.000	0.000
13	573818	158760	0.000	5.959	0.000	0.000	0.000
14	573812	158749	5.489	5.959	5.534	5.159	4.792
15	573810	158738	5.489	5.959	5.533	5.159	4.792
16	573828	158740	5.488	5.959	5.533	5.158	4.792
17	573832	158752	0.000	5.959	0.000	0.000	0.000
18	573838	158769	5.491	5.960	5.536	0.000	0.000
19	573850	158765	5.490	5.960	5.535	0.000	0.000
20	573862	158761	5.489	5.960	5.534	5.160	0.000
21	573845	158752	5.489	5.960	5.533	5.159	4.797
22	573861	158747	5.489	5.960	5.534	5.159	4.797
23	573855	158738	5.489	5.960	5.533	5.159	4.796
24	573842	158740	5.488	5.959	5.533	5.159	0.000
25	573822	158785	5.493	5.960	5.537	0.000	0.000

Data taken from North Kent Coast Modelling and Mapping Study, completed by JBA Consulting, in August 2013.

There are no health warnings or additional information for these levels or the model from which they were produced.

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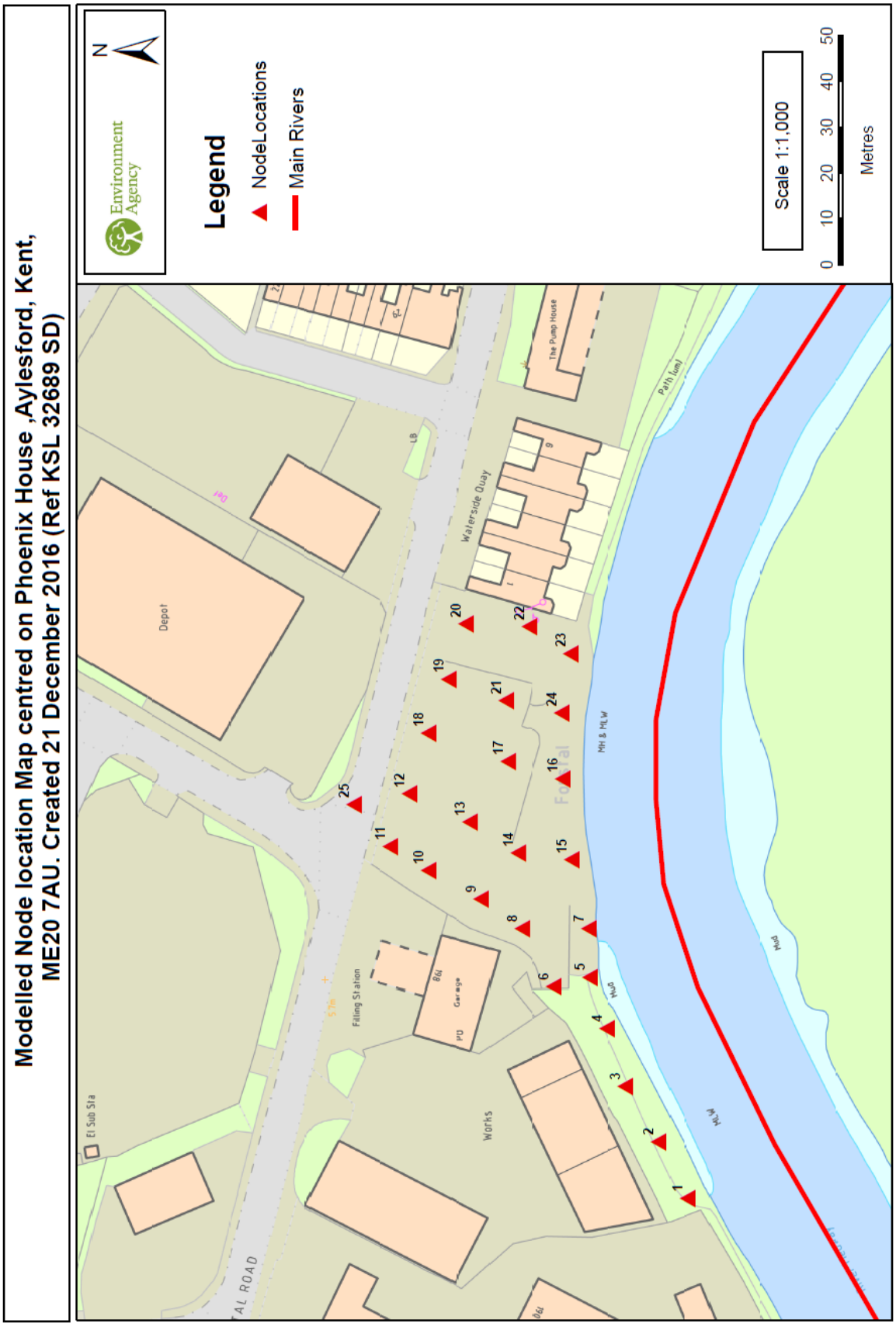

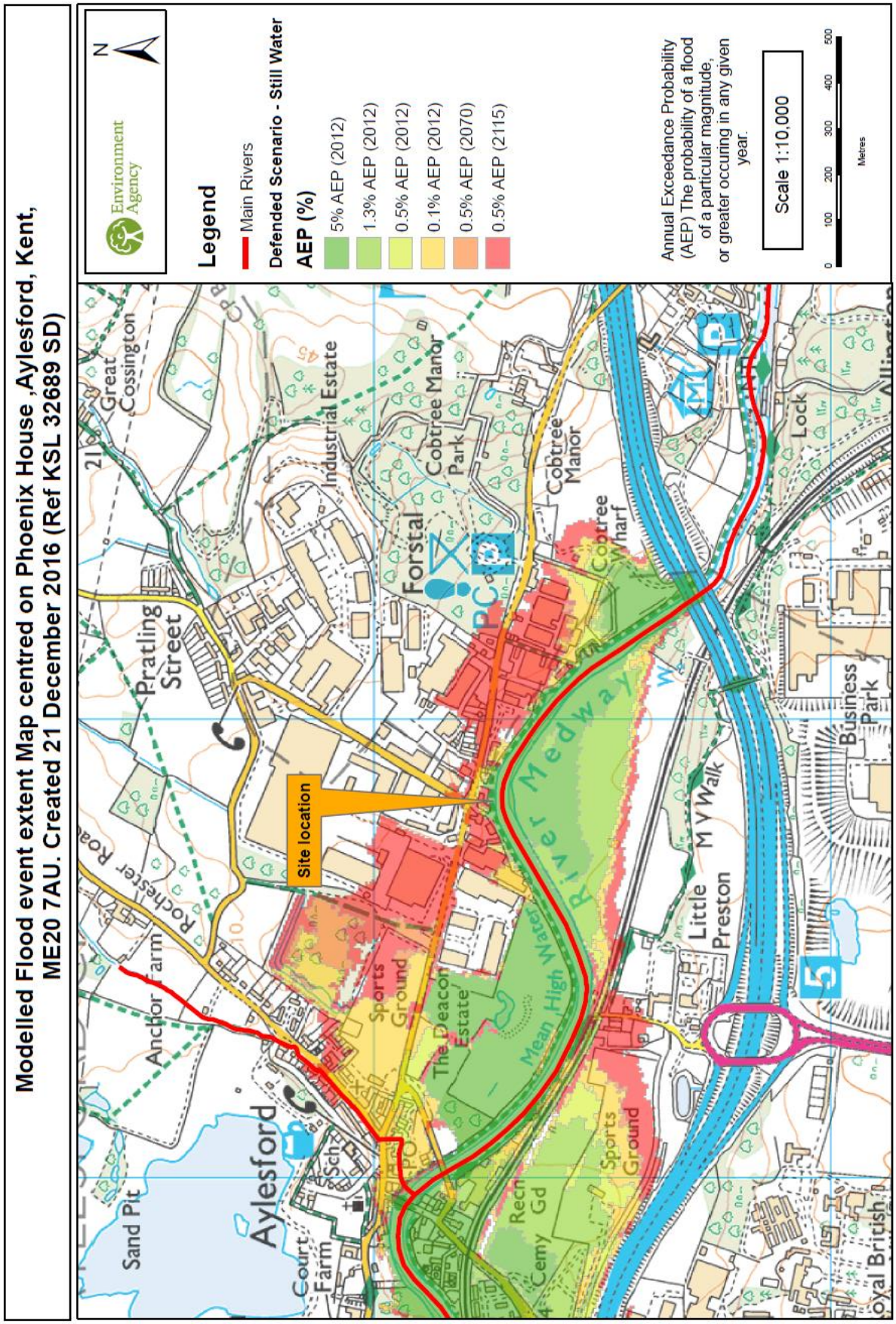

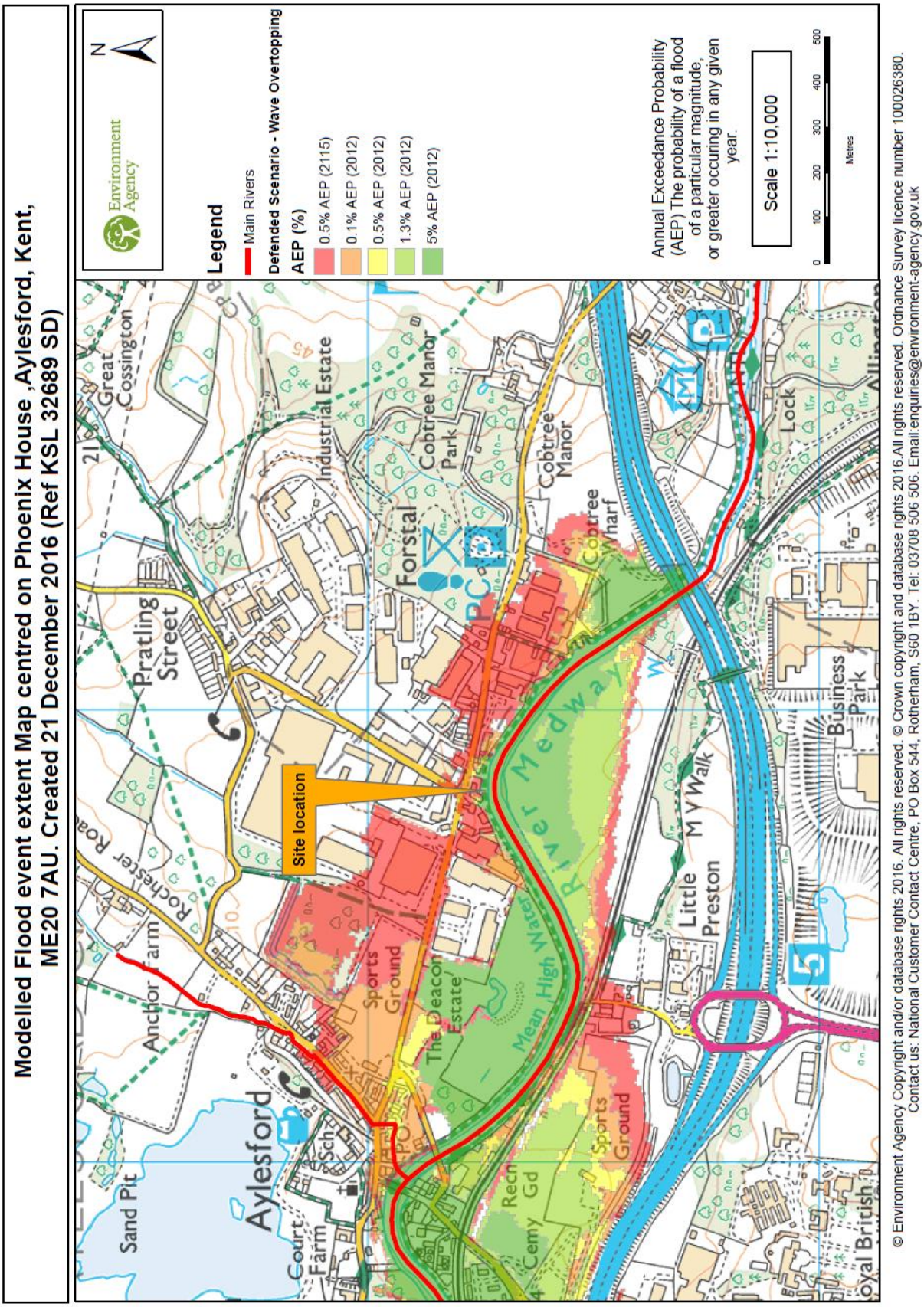

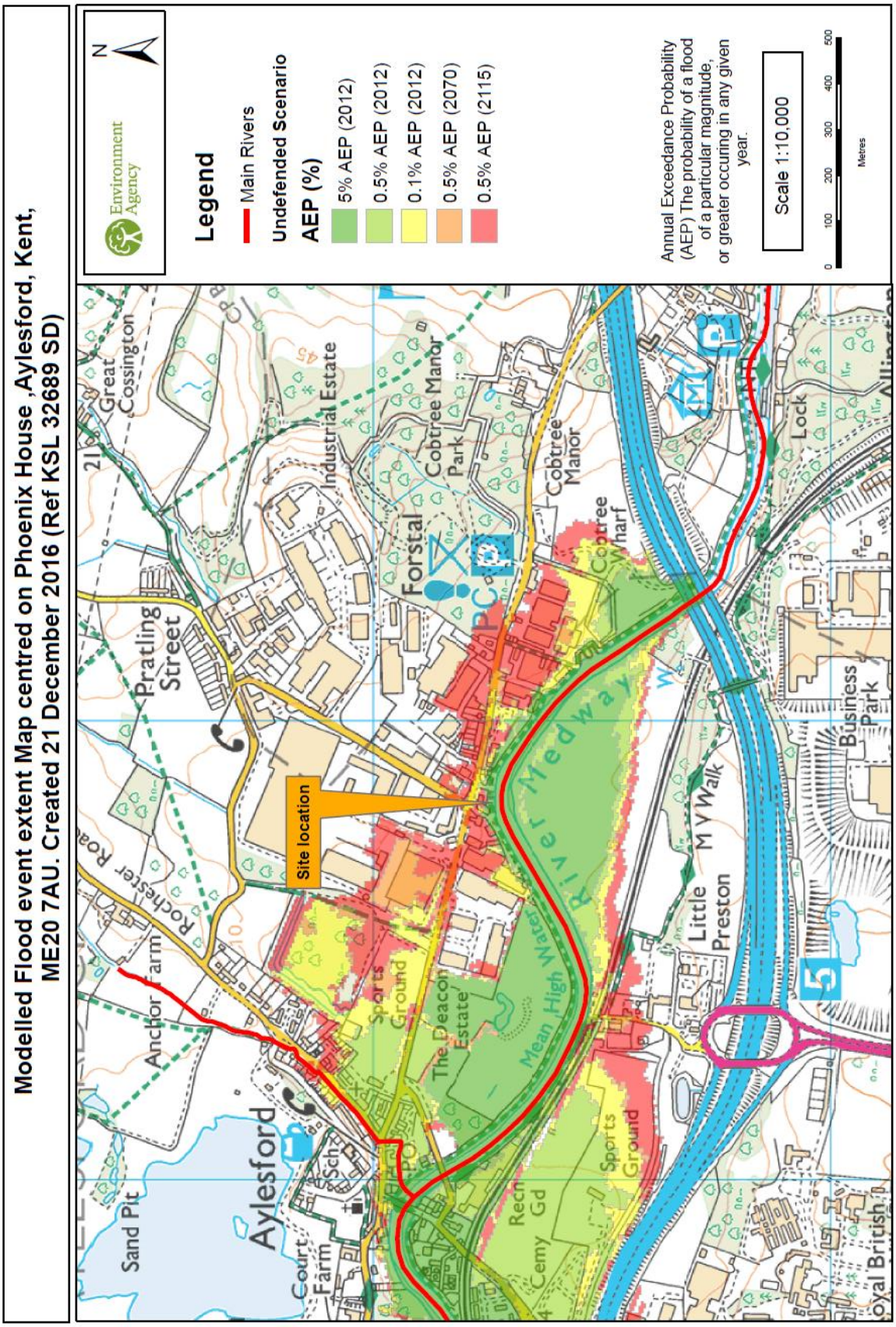

Defence Details

There are no formal flood defences owned or maintained by the Environment Agency in the area of this site/ property.

Orchard House, Endeavour Park, London Road, Addington, West Malling, Kent, ME19 5SH.
Email: kslenquiries@environment-agency.gov.uk

Historic Flood Data

We hold records of historic flood events from rivers and the sea. Information on the floods that may have affected the area local to your site are provided below and in the enclosed map (if relevant).

Flood Event Data

Areas in close proximity to the site flooded in February 1953, November 1960, December 1965 and October 2000.

Please note that our records are not comprehensive. We would therefore advise that you make further enquiries locally with specific reference to flooding at this location. You should consider contacting the relevant Local Planning Authority and/or water/sewerage undertaker for the area.

We map flooding to land, not individual properties. Our historic flood event record outlines are an indication of the geographical extent of an observed flood event. Our historic flood event outlines do not give any indication of flood levels for individual properties. They also do not imply that any property within the outline has flooded internally.

Please be aware that flooding can come from different sources. Examples of these are:
- from rivers or the sea;
- surface water (i.e. rainwater flowing over or accumulating on the ground before it is able to enter rivers or the drainage system);
- overflowing or backing up of sewer or drainage systems which have been overwhelmed,
- groundwater rising up from underground aquifers

Currently the Environment Agency can only supply flood risk data relating to the chance of flooding from rivers or the sea. However you should be aware that in recent years, there has been an increase in flood damage caused by surface water flooding or drainage systems that have been overwhelmed.

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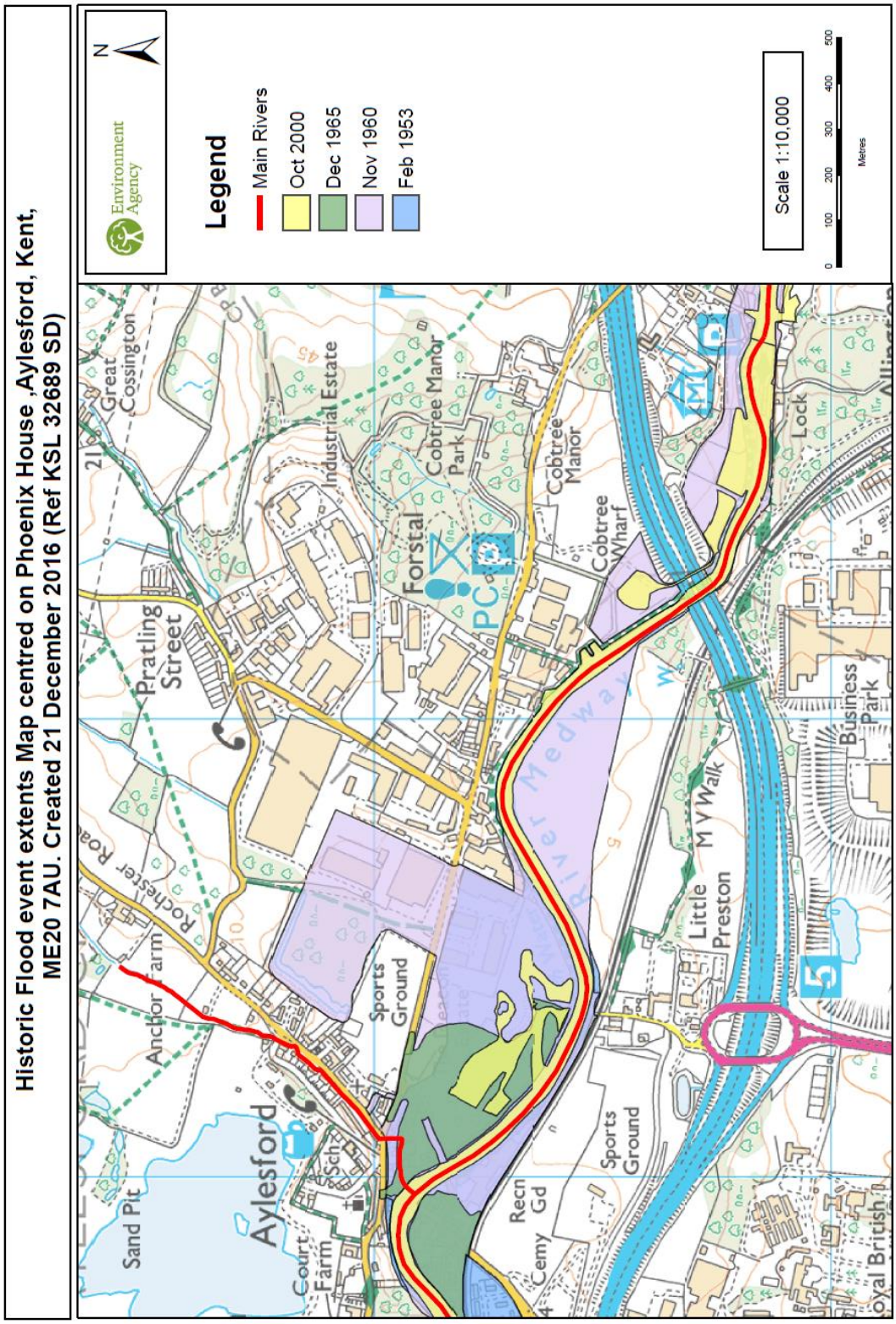

Additional Information

Use of Environment Agency Information for Flood Risk / Flood Consequence Assessments

Depending on the enquiry, we may also provide advice on other issues related to our responsibilities including flooding, waste, land contamination, water quality, biodiversity, navigation, pollution, water resources, foul drainage or Environmental Impact Assessment.

In **England**, you should refer to the Environment Agency's Flood Risk Standing Advice, the technical guidance to the National Planning Policy Framework and the existing PPS25 Practice Guide for information about what flood risk assessment is needed for new development in the different Flood Zones. These documents can be accessed via:

https://www.gov.uk/government/publications/flood-risk-standing-advice-for-local-planning-authorities-frsa
http://planningguidance.planningportal.gov.uk/

You should also consult the Strategic Flood Risk Assessment produced by your local planning authority.

You should note that:

1. Information supplied by the Environment Agency may be used to assist in producing a Flood Risk / Consequence Assessment (FRA / FCA) where one is required, but does not constitute such an assessment on its own.

2. This information covers flood risk from main rivers and the sea, and you will need to consider other potential sources of flooding, such as groundwater or overland runoff. The information produced by the local planning authority referred to above may assist here.

3. Where a planning application requires a FRA / FCA and this is not submitted or deficient, the Environment Agency may well raise an objection.

4. For more significant proposals in higher flood risk areas, we would be pleased to discuss details with you ahead of making any planning application, and you should also discuss the matter with your local planning authority.

Orchard House, Endeavour Park, London Road, Addington, West Malling, Kent, ME19 5SH.
Email: kslenquiries@environment-agency.gov.uk

Environment Agency

Surface Water

We have provided two national Surface Water maps, under our Strategic Overview for flooding, to your Lead Local Flood Authority – Medway / Kent County Council, who are responsible for local flood risk (i.e. surface runoff, ground water and ordinary watercourse), which alongside their existing local information will help them in determining what best represents surface water flood risk in your area.

Medway / Kent County Council have reviewed these and determined what it believes best represents surface water flood risk. You should therefore contact this authority so they can provide you with the most up to date information about surface water flood risk in your area.

You may also wish to consider contacting the appropriate relevant Local Planning Authority and/or water/sewerage undertaker for the area. They may be able to provide some knowledge on the risk of flooding from other sources. We are working with these organisations to improve knowledge and understanding of surface water flooding.

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Appendix C – Information Relating To JFLOW

JFLOW and flood outlines (Source: EA)

Flood Zones have been produced using JFLOW, a nationally consistent model. JFLOW has been used to produce the 1% (1 in 100 year) and 0.1% (1 in 1000 year) flood outlines.

The flood outlines have been developed by applying flow and tide models to a 3D ground level map of England and Wales, known as a Digital Terrain Model (DTM). This is created by flying an aircraft over the whole of the country using radar to record and create a contoured model of the land. This DTM is used as the basis of a grid of cells which is used to estimate the extent of flooding in a flood of a given return period or probability.

The size of the flood event (1 in 100 or 1 in 100 year) is determined by the inflows to the JFLOW model, which are calculated using statistical techniques from the Flood Estimation Handbook. The technique used is based upon catchment descriptors and data transfer, the details of these can be found in the Flood Estimation Handbook volume 3. The Flood Estimation Handbook provides a consistent technique for estimating inflows to the national model and its methods are widely accepted.

The methodology is a raster-based approach, driven by an underlying Digital Elevation Model (DEM).

- Each cell has a ground level and water depth
- Water can move to any of surrounding 8 cells where the water level is lower
- Water will pond in low spots until the water level is high enough to spill
- The velocity of movement depends on water surface slope and surface roughness

The above points describe the basic principles of the model. The two underlying principles are:

- Mass conservation within each cell
- Calculation of the fluxes between the cells

Each grid cell is treated as a small storage area. Mass conservation is applied to each grid cell. The flux between cells is calculated using a form of the generalised weir equation.

Efficient coding is achieved by keeping a list of all currently wet cells and a list of newly wet cells. This avoids having to search through each cell in the ground grid.

For whole catchment modelling, the hydrographs used as inflow boundary conditions represent the whole hydrograph at that inflow location and a simple conceptual method has been derived to account for the amount of flow within the channel banks. A simple solution was therefore sought which would approximately account for the proportion of flow contained within the channel without requiring further information about the channel.

The simple conceptual method used involves two assumptions:

1. That bankfull flow (Q_b) is equal to QMED as calculated by the Flood Estimation Handbook (FEH) methods. QMED has a return period of 2 years. This assumption derives from the

concept of dominant discharge in fluvial geomorphology (Wolman and Leopold, 1957; Wolman and Miller, 1960) where the cross-section shape is assumed to be formed by a discharge with a recurrence interval of 1-2years.

2. That the additional channel flow (Q_c) scales with both Q_b and depth above bankfull (d).

The basis of the current model is that each grid cell acts as a small flood cell and the links to each of the surrounding cells are automatically calculated. It is therefore capable of simulating the inundation extent at a level of detail equal to the underlying DEM. It is fundamentally volume conservative and so, in a given time period, will simulate the peak water levels across the floodplain depending on the volume of water that has entered the floodplain. This approach is a half-way house between the common 1D hydrodynamic models and a 2D hydrodynamic model.

Limitations

JFLOW was used to produce flood maps for the whole of England and Wales for all catchments greater than 3 sq-km in a consistent manner. The method is therefore very generalised and therefore cannot take account of information that may be very significant locally. This might include:

1. Effects of bridges and other structures including flood defences are not taken into account.
2. Errors in the DTM, caused by trees and buildings for example.
3. The effect of reservoirs and urban drainage and other man made influences on the flow regime can only be taken into account in a very general sense in JFLOW.
4. The channel is assumed to be able to take the 2 year flow. This may not be true especially in those modified by man.
5. Hydraulic roughness is assumed to be the same everywhere in JFLOW, but of course it is not.

For these and many other reasons, the flood outlines produced by JFLOW can only be taken as a rough guide, showing where more detailed flood risk assessments are essential. Flood risk assessments should also be undertaken near small watercourses whose catchments are too small to have been included in the JFLOW modelling.