

***RIVER AVON TIDAL FLOOD RISK
MANAGEMENT STRATEGY***

***Defacto Defences, Pill and
Shirehampton updates***

Technical Note

January 2017

Prepared for Bristol City Council

Issue	Date	Details	Prepared by	Checked by	Approved by
1	15/08/16	Draft for client review	Ben Taylor Assistant Consultant Richard Moore Senior Assistant Flood Risk Consultant	Jon Short Principal Consultant	
2	21/10/2016	Final - response to client comments	Ben Taylor Assistant Consultant Richard Moore Senior Assistant Flood Risk Consultant	Jon Short Principal Consultant Mark Davin Principal Engineer Jason Drummond Principal Flood and Coastal Specialist	David Dales Director
3	19/01/17	Revised final – in response to residual comments	Ben Taylor Assistant Consultant	Jason Drummond Principal Flood and Coastal Specialist	David Dales Director

Scott House
 Alencon Link
 Basingstoke
 Hampshire
 RG21 7PP

Limitations

AECOM Infrastructure & Environment UK Limited (“AECOM”) has prepared this Report for the sole use of Bristol City Council (“Client”) in accordance with the Agreement under which our services were performed **River Avon Tidal Flood Risk Management Strategy RESP1007626 (23/10/15) and Response to Tender Submission Clarifications (03/11/15) (the “Agreement”)**. The report takes into account the particular instructions and requirements of the Client in accordance with the provisions of the Agreement. It is not intended for and cannot be relied upon by any third party. No liability is accepted by AECOM and no responsibility is undertaken to any third party.

Information obtained by AECOM has not been independently verified by AECOM, unless otherwise stated in the Report.

The methodology adopted and the sources of information used by AECOM in providing its services are outlined in this Report. The work described in this Report was undertaken between March 2016 and January 2017 and is based on the conditions encountered and the information available during the said period of time. The scope of this Report and the services are accordingly factually limited by these circumstances.

Where assessments of works or costs identified in this Report are made, such assessments are based upon the information available at the time and where appropriate are subject to further investigations or information which may become available.

Copyright

© This Report is the copyright of AECOM Infrastructure & Environment UK Limited. Any unauthorised reproduction or usage by any person other than the addressee is strictly prohibited.

TABLE OF CONTENTS

1	INTRODUCTION	4
1.1	Overview and purpose of this report	4
2	DEFACTO DEFENCES	5
2.1	Background.....	5
2.2	Previous work	5
2.3	Scope of updates.....	5
2.4	Cumberland Road.....	5
2.5	Commercial Road.....	7
2.6	Cattle Market Road.....	8
2.7	St. Phillips.....	9
2.7.1	Totterdown (Cattle Market Road to Bristol Electric Centre)	9
2.7.2	RSPCA Bristol Dogs and Cats Home to Albert Road	9
2.7.3	Albert Road Bridge to Travis Perkins	11
2.8	GIS analysis and figures of areas protected	11
2.8.1	Cattle Market Road.....	12
2.8.2	RSPCA Dogs and Cats Home to Albert Road	13
2.8.3	Albert Road Bridge to Travis Perkins.....	14
3	PILL AND SHIREHAMPTON UPDATES	16
3.1	Introduction.....	17
3.2	Issues and Limitations	17
3.3	Mapping Methodology	18
3.4	Do Nothing.....	19
3.5	Do Minimum.....	19
3.6	Do Something (Option Testing)	24
3.7	1D Mapping Limitations	29
3.8	Fluvial Flood Risk	31
3.9	Conclusion	33
4	REFERENCES	34
5	APPENDICES.....	35
5.1	Appendix A: Pill / Shirehampton Do Nothing Flood Maps	
5.2	Appendix B: Pill / Shirehampton Do Minimum Flood Maps	
5.3	Appendix C: Pill / Shirehampton Do Something Flood Maps	

1 INTRODUCTION

1.1 Overview and purpose of this report

Following a review of the original modelling outputs, and instruction by BCC, modifications and updates to the Strategy baseline numerical modelling have been made to provide more robust outputs to inform the assessment of economic damages and benefits in the Strategy.

The updates include:

- Inclusion of third party 'defacto defence' structures in the central Bristol area to better represent the role of existing structures such as buildings, private walls and other raised structures on the flood modelling extent; and
- Improved model representation of existing defences for the Pill and Shirehampton region.

This report describes both streams of updates; the defacto defence updates and the improved representation at Pill / Shirehampton. The impact of the updates on the flood modelling extent is presented.

2 DEFACTO DEFENCES

2.1 Background

A flood defence is a structure that alters the natural flow of water or flood water for the purpose of flood risk management. Defences can be formal structures or 'informal' or 'defacto' assets. A 'formal' flood defence is a structure that is maintained by its respective owner for flood management purposes. A 'defacto' defence is a structure not built and/or maintained for the primary purpose of flood defence, but which limits the spread of flooding as a secondary or indirect purpose, for example, a boundary or garden wall.

2.2 Previous work

The need to investigate the impact of so called 'defacto' defences on the numerical flood modelling outputs was highlighted during the Central Area Flood Risk Assessment (CAFRA) studies. The performance of defacto defences is summarised in Hyder (2015). Hyder compared predicted and observed flood levels in the defacto areas and concluded that the numerical modelling:

"does not match observed flood events well where existing walls and buildings form defacto defences and restrict flood flow on the floodplain".

Ove Arup and Partners Ltd (Arup) were commissioned by BCC in January 2016 to complete a visual condition assessment of identified buildings, walls and other raised structures to estimate the likely depth of water that these can resist. The estimates were based on identified assumptions and recommendations for ongoing management measures. The areas within central Bristol that have been considered include:

- Cumberland Road;
- Commercial Road;
- Cattle Market Road; and
- St. Phillips

Following the site walkover and based on the visual assessment, Arup made estimates as to the likely depth of water that the defacto defences could potentially withstand before collapsing (in March 2016). Arup also estimated the current standard of protection (SoP) provided by each defacto defence. For more details about the visual assessment and the analysis that was undertaken, refer to the Visual Walkover Structural Assessment Report (Arup, 2016).

2.3 Scope of updates

The evidence provided in the Visual Walkover Structural Assessment Report (Arup, 2016) has been used to consider the impact of the defacto defences on the baseline numerical modelling outputs. The impact of the defacto defences have been proportionately accounted for by revising the properties considered at risk in the baseline flood modelling. This has been done using GIS based techniques.

As agreed in the scope of the additional work, the impact of the defacto defences has only been considered for the time periods 2015 and 2030. After this, it is assumed that the defacto defences cannot be relied upon to provide a flood defence function as it is difficult to estimate the condition of the defences this far into the future.

The following sections provide an overview of the defacto defences and how they have been incorporated in each area.

2.4 Cumberland Road

The defacto defences at Cumberland Road consist of two parallel structures; a composition of boundary walls to the north of Cumberland Road (herein referred to as the 'north' wall), and a stone masonry wall to the south of Cumberland Road adjacent to the ongoing Metrobus construction area (herein referred to as the 'south' wall).

The Visual Walkover Structural Assessment Report (Arup, 2016) estimated that the north wall could protect to a water level of 9.85m AOD before failure whereas the south wall could protect to a water level of 9.30m AOD before failure. These water levels and standards of protection which these equate to are presented in **Table 1** below.

Table 1. Estimated water level of failure and standard of protection for Cumberland Road

Structure	Estimated water level prior to failure (m ODN)	Standard of protection	Condition grade (Arup visual assessment report, 2016)
Cumberland Road North Wall	9.85m	2015 - 1:1000yr and below 2030 - 1:1000yr and below	4 (poor)
Cumberland Road South Wall	9.30m	2015 - 1:200yr and below 2030 - 1:200yr and below	3 (fair)

Evidence collected during the visual assessment indicated that the condition of the north wall is grade 4 (poor). Therefore for the purpose of this study it has been assumed that this structure cannot be relied upon as a defacto defence past 2015 (the present day), and for 2030 and onwards the north wall will not provide flood risk protection benefits. The condition of the south wall is grade 3 and it has been assumed that this defence will act as a defacto defence in 2015 and 2030.

A visual inspection of the baseline numerical flood modelling extents suggests that both structures may contribute to the protection of the same properties. When the defacto defences are not considered (as in the baseline modelling extents) the properties behind the defences are at risk from a 2015 and 2030 1:200 year events and greater.

One may expect the north wall to provide a form of flood protection to the properties at risk given that its estimated standard of protection is 1:1000yr. However, upon inspection it is clear that the baseline flood extents actually outflank the defacto defences during events of 1:200 year and greater and flooding would be expected to propagate around the back of the defacto defences (see **Figure 1**). As a result of the outflanking the defacto defences at Cumberland Road are unlikely to provide a flood risk benefit compared to the existing baseline flood modelling for this area. Therefore no adjustments to the properties at risk in the baseline flood modelling were made as a result of the review of defacto defences at Cumberland Road.

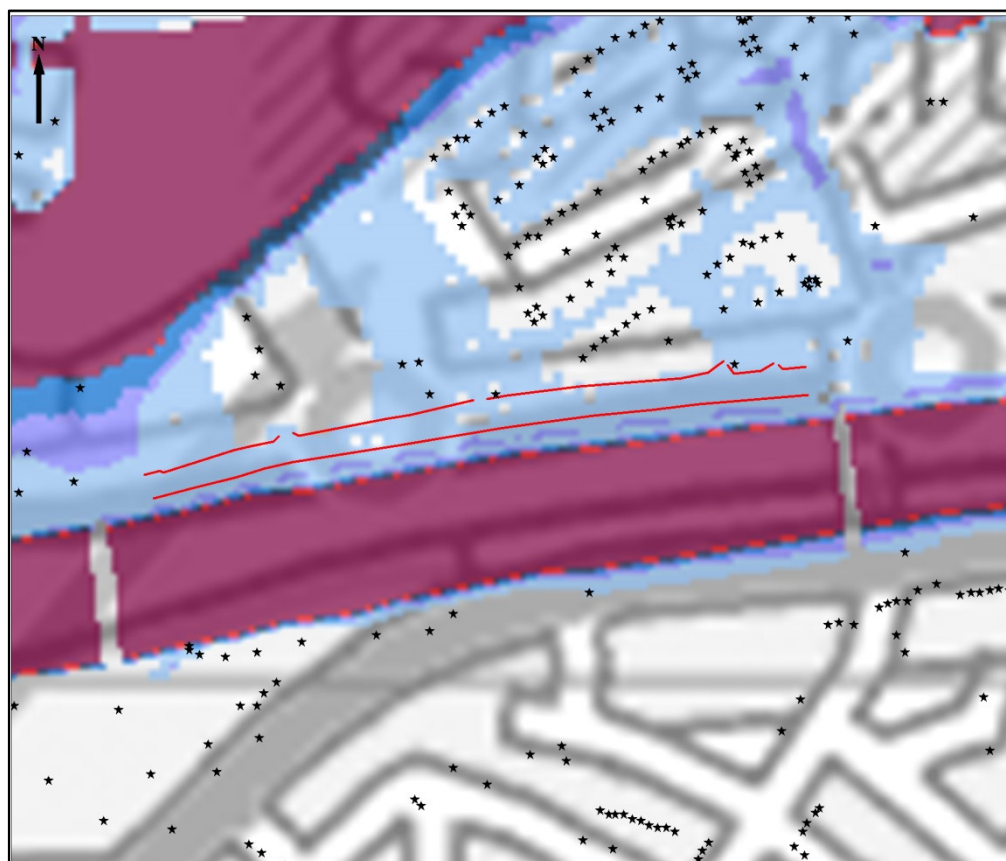


Figure 1 Outflanking at the north and south defacto defence wall alignments at Cumberland Road. Flood mapping shown is the baseline 2015 1:200 event

2.5

Commercial Road

The defacto defence at Commercial Road consists of a clay brick wall which runs along the north side of the road adjacent to Bathurst Basin.

The Visual Walkover Structural Assessment Report (Arup, 2016) estimated that the structure could protect to a water level up to 9.35m AOD. This equates to approximately a 1:200 year standard of protection for 2015 and less than a 1:200 year standard for 2030. This is shown in **Table 2** below.

Table 2. Estimated water level of failure and standard of protection for Commercial Road

Structure	Estimated water level prior to failure (m ODN)	Standard of protection	Condition grade (Arup visual assessment report, 2016)
Commercial Road	9.35m	2015 - 1:200yr and below 2030 - less than 1:200yr	4 (poor)

The masonry clay brick wall is considered to be of condition grade 4 (poor) and it cannot be claimed with any form of confidence that the wall would be able to provide flood protection benefits for more than 10 years. For the purpose of this study it is assumed that this defence will act as a defacto defence in 2015, but not in 2030.

When inspecting the baseline flood model extents there are no properties immediately behind the defence alignment which are considered at risk. The defence is situated across a potential flow route for water to enter the floating harbour (to the north) but the flood risk benefit is likely to be limited given that the defence stops at Guinea Street and therefore flood waters would outflank the defence in this location. As a result of this, the defacto defence at Commercial Road is unlikely to provide an improved standard of flood protection to the harbour and therefore no adjustments to the properties at risk in the baseline flood modelling were made.

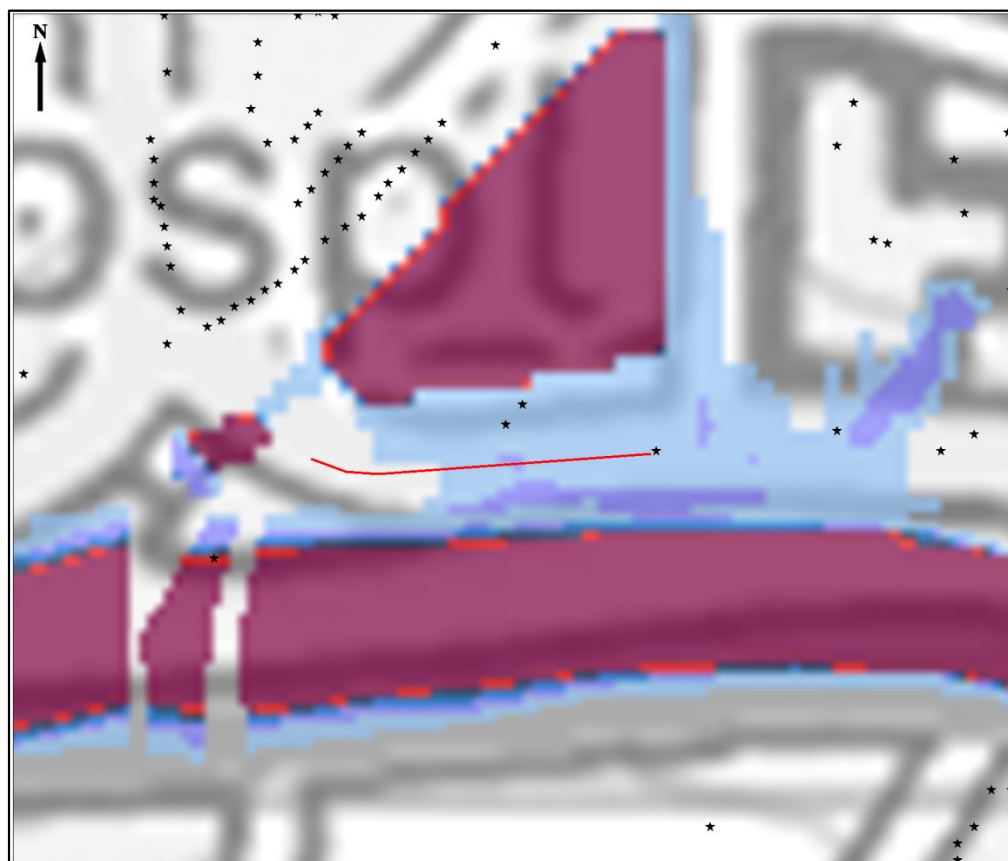


Figure 2 Outflanking at the defacto defence wall alignment at Commercial Road. Flood mapping shown is the baseline 2015 1:200 event

2.6

Cattle Market Road

The defacto defence at Cattle Market Road consists of a building wall that is currently unoccupied. The lowest window, which would probably be a weak link in terms of flood defence, is around 2.4m above ground level. There was no access granted to the inside of the property so there is considerable uncertainty surrounding the stability of the building wall during flood conditions.

The Visual Walkover Structural Assessment Report (Arup, 2016) estimated that the structure could protect to a water level of 9.3m before failure. In this location this equates to approximately a 2015 and 20301:100 year standard of protection. This is shown in **Table 3** below.

Table 3 Estimated water level of failure and standard of protection for Cattle Market Road

Structure	Estimated water level prior to failure (m ODN)	Standard of protection	Condition grade (Arup visual assessment report, 2016)
Cattle Market Road	9.30m	2015 - 1:100yr and below 2030 - 1:100yr and below	2 (good)

Evidence collected during the visual assessment indicated that the condition of the building wall is grade 2 (good) and it has therefore been assumed that the wall can provide a flood defence function in years 2015 and 2030.

Inspection of the baseline flood model extent shows a small flood cell adjacent to the defacto defence alignment at Cattle Market Road. The defacto defence is therefore likely to provide a flood risk benefit to this area. It has been assumed that the wall provides protection up to and including a 1:75 year event in both 2015 and 2030. A total of seven properties benefit from this and the flood damages to these properties for the specified flood events were removed from the economic flood damages assessment.

2.7 St. Phillips

A number of defacto defence areas are present at St. Phillips including at:

- Totterdown (Cattle Market Road to Bristol Electric Centre);
- RSPCA Bristol Dogs and Cats Home to Albert Road Bridge; and
- Albert Road Bridge to Travis Perkins

Each of these areas is discussed in turn in the sections below.

2.7.1 *Totterdown (Cattle Market Road to Bristol Electric Centre)*

Part of the Environment Agency’s Totterdown flood defence scheme constructed in 1992, this scheme relies heavily on privately-owned defacto defences. Along this section the defacto defences comprise a range of structures, including a stone wall, a brick wall, steel panels and a concrete wall.

The Visual Walkover Structural Assessment (Arup, 2016) identified a weak link in the defences where a section of brick wall located behind steel panels has failed (i.e. condition grade 5). The footpath in-front of the failed section is approximately 8.6m ODN which falls at or below the 1:2 yr standard of protection for 2015 and 2030.

Table 4 Estimated water level of failure and standard of protection for Totterdown

Structure	Estimated water level prior to failure (m ODN)	Standard of protection	Condition grade (Arup visual assessment report, 2016)
Totterdown (Cattle Market Road to Bristol Electric Centre)	8.60m	2015 – 1:2yr 2030 - less than 1:2yr	5 (failed)

The defacto defences at Totterdown are adjacent to a number of properties which are at risk from the 2015 1:2yr return period event and greater (i.e. the lowest magnitude event that was simulated in the baseline numerical modelling). However, inspection of the baseline flood mapping shows that for low magnitude flood events the flood water does not propagate across the defacto defence alignment in this location, but instead comes from the area to the south, at the RSPCA Bristol Dogs and Cats Home. For higher magnitude flood events the water levels are greater than the footpath level in-front of the failed section of defacto defences and they are unlikely to provide any form of flood defence protection.

For the reasons stated above, at Totterdown (between Cattle Market Road and the Bristol Electric Centre), the defacto defences do not provide any increase in standard of protection to the properties behind and therefore, as a result of these defences alone, no adjustments to the flood damages to the properties adjacent to the defences are required.

2.7.2 *RSPCA Bristol Dogs and Cats Home to Albert Road*

To the south of the Totterdown section of defacto defences is the RSPCA Bristol Dogs and Cats Home defacto defences which comprise sections of wall and palisade fence. There are also various defacto defences to the east of the Dogs and Cats Home in the area extending to Albert Road Bridge.

Table 5 below outlines the estimated water levels which the various defacto defence sections at the Dogs and Cats home and to Albert Road can be expected to protect against and the corresponding standards of protection at the location.

The condition of the defacto defences in this area varies, ranging between condition grades 1 (very good) to 4 (poor).

Table 5 Estimated water level of failure and standard of protection for the RSPCA Bristol Dogs and Cats Home

Structure	Estimated water level prior to failure (m ODN)	Standard of protection	Condition grade (Arup visual assessment report, 2016)
Bristol Dogs and Cats Home – wall beneath bridge	8.75m	2015 – 1:2yr 2030 - 1:2yr	Varied Ranging from 1 (very good) to 4 (poor)
Bristol Dogs and Cats Home – facility wall	9.05m	2015 – 1:20yr and below 2030 – 1:20yr and below	
Bristol Dogs and Cats Home – palisade fence	No defence structure. Ground level approx. 8.70m	2015 – 1:2yr 2030 – 1:2yr	
To Albert Road – freestanding concrete blocks	9.25m	2015 – 1:75yr and below 2030 – 1:75yr and below	
To Albert Road – Venture tyres building wall	9.60m	2015 – 1:200yr and below 2030 – 1:200yr and below	
To Albert Road – Venture tyres palisade fence	No defence structure. Ground level approx. 8.90m	2015 – 1:2yr 2030 – 1:2yr	
Leitz tooling – building walls	9.60m	2015 – 1:200yr 2030 – 1:200yr	

The defacto defences in this area are situated in the path of a major flood route to the land behind where a number of properties are located and are considered to be at risk in the baseline numerical model flood mapping. As described in section 2.7.1, the flood cell also extends northwards, into the area behind the Totterdown defacto defences.

The section of palisade fencing at the Dogs and Cats Home represents a weak point in the system of defacto defences in this area. Another weak point exists at the section of palisade fence at Venture tyres. Whilst some sections of the defacto defences may provide a higher standard of protection, the system as a whole is exposed at its weak points and therefore the standard of protection afforded by the defacto defences in this area is only as high as a 1:2 year standard for 2015 and 2030. However this still represents an improvement in the standard of protection compared to the existing baseline numerical modelling extents which does not consider the impact of defacto defences at all.

Assuming the 1:2yr standard of protection (2015 and 2030), the properties in the area behind the defacto defences are expected to benefit in addition to the properties which are located behind the Totterdown defacto defences as the flood cell extends north to include this area. The flood damages to these properties for the 1:2 yr return period events in 2015 and 2030 were removed from the economic flood damages assessment.

2.7.3 *Albert Road Bridge to Travis Perkins*

A variety of structures act as defacto defences between Albert Road bridge to the Travis Perkins buildings including; brick building walls, freestanding boundary walls, a dwarf wall, panel clad building walls and other types of wall.

The condition of the defacto defences varies, ranging from condition grades 2 to 4. Given the number of different structures in this area it is impractical to make an estimate as to how long the defacto defence system may provide a flood risk protection. It has been assumed that the defacto defences could provide protection for 2015 and 2030.

The Visual Walkover Structural Assessment (Arup, 2016) identified a weak link in the defences at the dwarf wall (in terms of height, rather than condition). The wall has a palisade fence along its crest but this provides no additional flood defence function. A flood pathway over the dwarf wall exists which allows flood water to propagate into the flood cell behind. The dwarf wall is the weak link in the system and therefore, whilst some of the other defacto defence structures have higher standards of protection, the standard for the system as a whole is limited to that which is provided by the dwarf wall.

The dwarf wall is in good condition (condition grade 2) and the estimated water level prior to failure for the wall is 9.35m ODN. In 2015 and 2030 this equates to between a 1:100 to 1:200 yr standard of protection. Compared to the baseline numerical flood modelling, this represents a significant improvement in the standard of protection provided to the area.

The economic damages to the properties in the area behind the defacto defences for the flood events the defences protect against have been removed from the economic assessment. Assuming a 1:100 year standard of protection, the damages associated with the 1:2, 1:20 and 1:75 yr flood events have been removed.

2.8 **GIS analysis and figures of areas protected**

In order to identify the properties benefiting from the defacto defences it was necessary to undertake a GIS based analysis.

The analysis involved identifying the alignments of the defacto defences and visually comparing the alignments to the baseline flood mapping produced by the numerical modelling. Considering the assumptions relating to the standard of protection (presented in sections 2.4 to 2.7) the properties protected from the defacto defences were identified. Shapefiles were created which show the areas benefiting from the defacto defences.

Based on the evidence presented in sections 2.4 to 2.7, the defacto defences in the following areas have been identified as having a flood risk impact to the properties at risk compared to the baseline flood modelling:

- Cattle Market Road;
- RSPCA Dogs and Cats Home to Albert Road; and
- Albert Road to Travis Perkins

The following sections present figures showing the areas benefiting from the defacto defences at each location.

2.8.1

Cattle Market Road

Figure 3 below presents the area protected by the defacto defences at Cattle Market Road. In the updated economic assessment, the defacto defences provide protection to the following events:

- 2015 1:2 yr, 1:20 yr and 1:75 yr
- 2030 1:2 yr, 1:20 yr and 1:75 yr

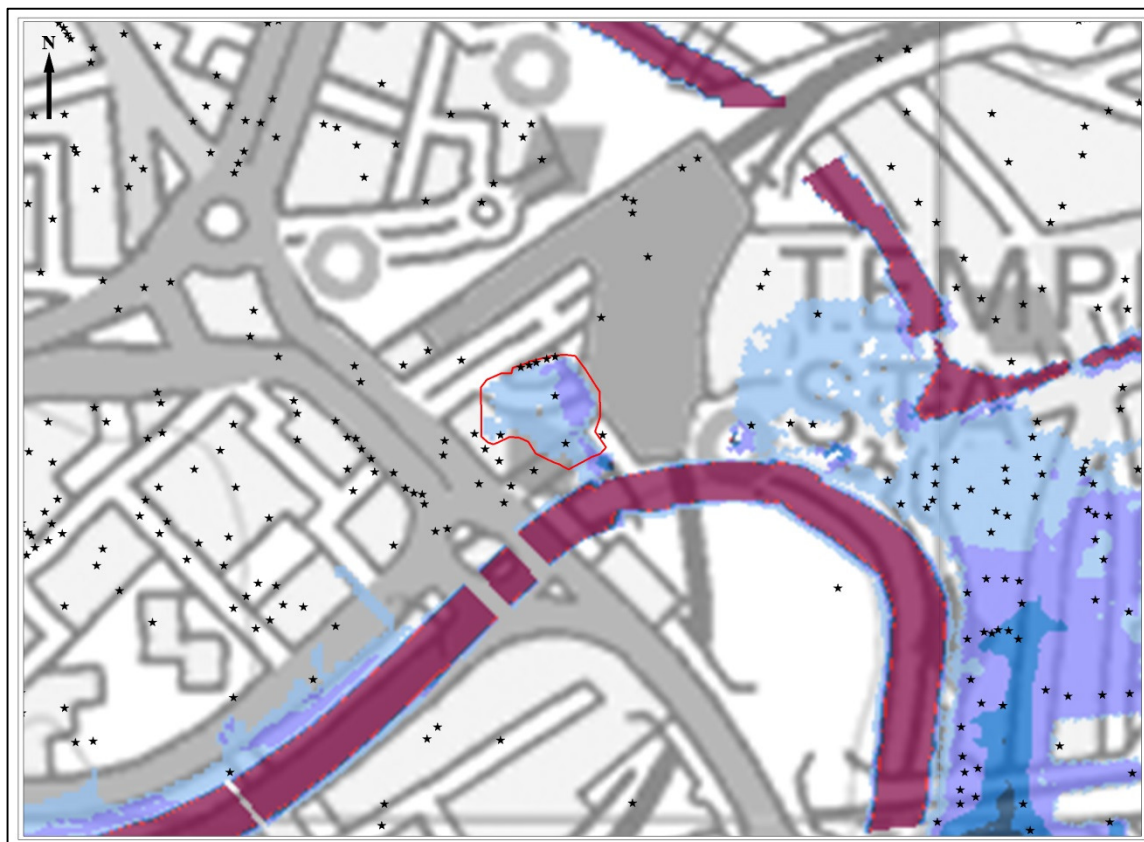


Figure 3 The area protected by the defacto defences at Cattle Market Road. Flood mapping shown is the baseline 1:75 yr flood event in 2030

2.8.2 *RSPCA Dogs and Cats Home to Albert Road*

Figure 4 below presents the area protected by the defacto defences at the RSPCA Dogs and Cats Home to Albert Road. As can be seen, the flood cell extends north into the area behind the Totterdown defacto defences. In the updated economic assessment, the defacto defences provide protection to the following events:

- 2015 1:2 yr
- 2030 1:2 yr

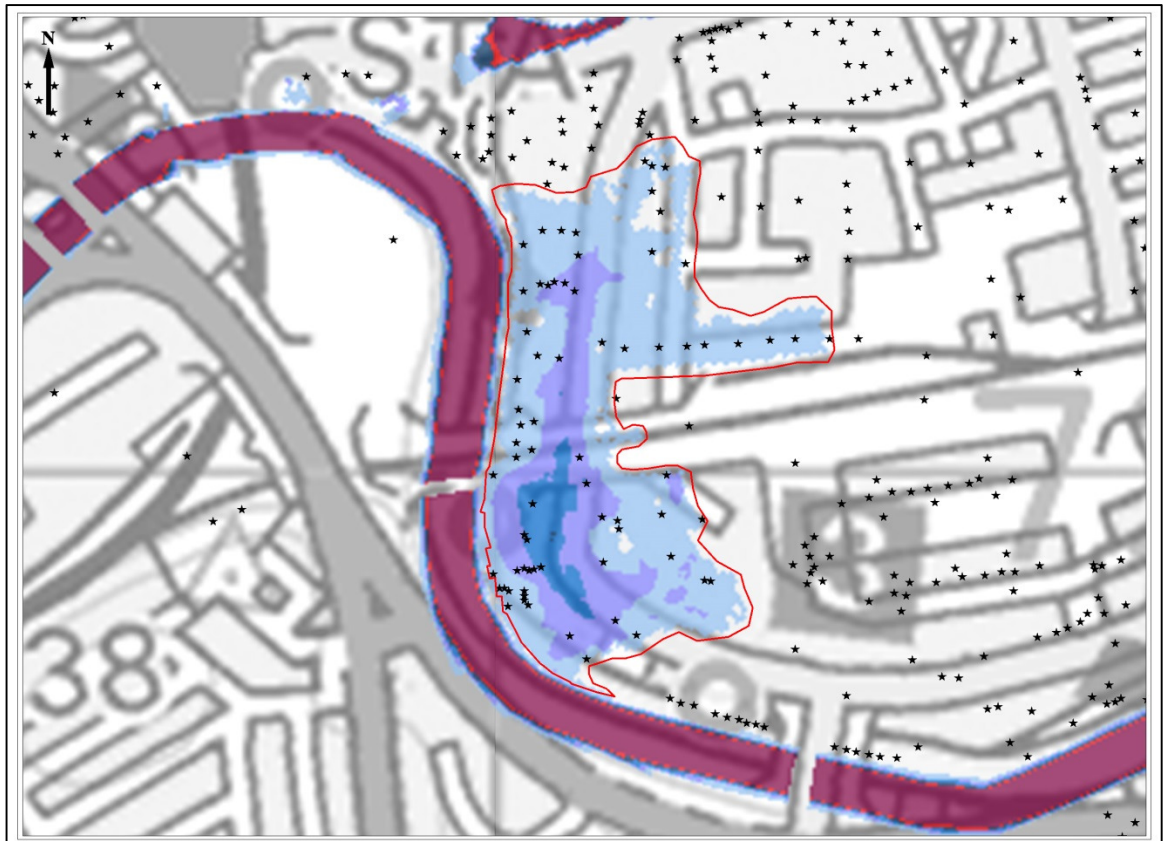


Figure 4 The area protected by the defacto defences at the RSPCA Dogs and Cats Home to Albert Road. Flood mapping shown is the baseline 1:2 yr flood event in 2030

2.8.3 **Albert Road Bridge to Travis Perkins**

Figure 5 below presents the area protected by the defacto defences between Albert Road Bridge and the Travis Perkins buildings. In the updated economic assessment the defacto defences provide protection to the following events:

- 2015 1:2 yr, 1:20 yr and 1:75 yr
- 2030 1:2 yr, 1:20 yr and 1:75 yr

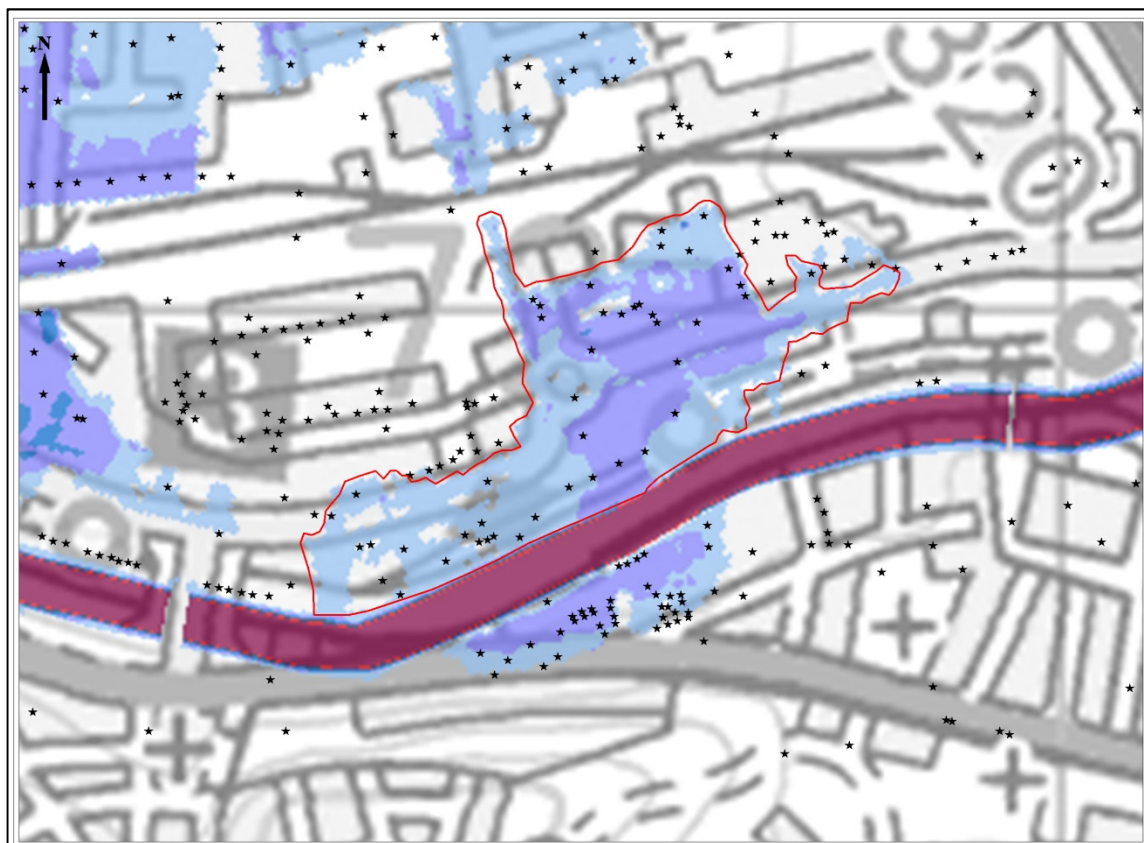


Figure 5 The area protected by the defacto defences at Albert Road Bridge to Travis Perkins. Flood mapping shown is the baseline 1:75 yr flood event in 2030

2.9 **Summary of updates**

The change in Do Minimum economic damages in the defacto defence areas resulting from the update is a reduction in PV damages of approximately £53million.

Table 6 to **Table 8** present the number of properties in the defacto defence areas at risk from various return period events before and after the updates. The tables only show property counts from the defacto defence areas at Cattle Market Road, the RSPCA Dogs and Cats Home to Albert Road and Albert Road to Travis Perkins as these are the areas where updates to the properties at risk have been made. Elsewhere (i.e. Cumberland Road, Commercial Road etc.), the assessment suggests that the defacto defences do not increase the standard of protection.

The tables demonstrate that for the economic assessment the defacto defence updates have reduced the number of properties at risk from the lower return period events in 2015 and 2030. During the 1:20 and 1:75yr events for 2015 and 2030, approximately 68 properties remain at risk in the defacto defence areas. These properties are located between the RSPCA Dogs and Cats Home and Albert Road, with the defacto defence in this area only providing protection upto a 1:2 year standard. The change in Do

Minimum economic damages in the defacto defence areas resulting from the update is a reduction in PV damages of approximately £53million.

Table 6 Numbers of properties at risk in the defacto defence areas prior to the updates being undertaken (Do Minimum scenario). The numbers of residential properties (Res) and Commercial properties (Com) are shown.

Year	Return period				
	1:2yr	1:20yr	1:75yr	1:200yr	1:1000yr
2015	56 Res: 15 Com: 41	86 Res: 18 Com: 68	102 Res: 21 Com: 81	109 Res: 23 Com: 86	111 Res: 24 Com: 87
2030	77 Res: 16 Com: 61	89 Res: 20 Com: 69	106 Res: 23 Com: 83	109 Res: 23 Com: 86	111 Res: 24 Com: 87
2065	85 Res: 18 Com: 67	106 Res: 23 Com: 23	109 Res: 23 Com: 86	111 Res: 24 Com: 87	111 Res: 24 Com: 87
2115	104 Res: 22 Com: 82	110 Res: 24 Com: 86	110 Res: 24 Com: 86	111 Res: 24 Com: 87	111 Res: 24 Com: 87

Table 7 Numbers of properties at risk in the defacto defence areas after the updates (Do Minimum scenario). The numbers of residential properties (Res) and Commercial properties (Com) are shown.

Year	Return period				
	1:2yr	1:20yr	1:75yr	1:200yr	1:1000yr
2015	0 Res: 0 Com: 0	68 Res: 17 Com: 51	68 Res: 17 Com: 51	109 Res: 24 Com: 85	111 Res: 24 Com: 87
2030	0 Res: 0 Com: 0	68 Res: 17 Com: 51	68 Res: 17 Com: 50	109 Res: 23 Com: 86	111 Res: 24 Com: 87
2065	85 Res: 18 Com: 67	106 Res: 23 Com: 80	109 Res: 23 Com: 86	111 Res: 24 Com: 87	111 Res: 24 Com: 87
2115	104 Res: 22 Com: 82	110 Res: 24 Com: 86	110 Res: 24 Com: 86	111 Res: 24 Com: 87	111 Res: 24 Com: 87

Table 8 Changes in numbers of properties at risk in defacto defence areas (Do Minimum scenario). The numbers of residential properties (Res) and Commercial properties (Com) are shown.

Year	Return period				
	1:2yr	1:20yr	1:75yr	1:200yr	1:1000yr
2015	-56 Res: -15 Com: -41	-18 Res: -1 Com: -17	-34 Res: -4 Com: -30	0 Res: 0 Com: 0	0 Res: 0 Com: 0
2030	-77 Res: -16 Com: -61	-21 Res: -3 Com: -18	-38 Res: -6 Com: -33	0 Res: 0 Com: 0	0 Res: 0 Com: 0
2065	0 Res: 0 Com: 0	0 Res: 0 Com: 0	0 Res: 0 Com: 0	0 Res: 0 Com: 0	0 Res: 0 Com: 0
2115	0 Res: 0 Com: 0	0 Res: 0 Com: 0	0 Res: 0 Com: 0	0 Res: 0 Com: 0	0 Res: 0 Com: 0

3 PILL AND SHIREHAMPTON UPDATES

3.1 Introduction

The Hydraulic Modelling Report (AECOM, 2016), produced during option shortlisting, confirmed the extensive volume of hydraulic model development and associated information concerning flood risk within central areas of Bristol owned by BCC. In particular, as part of the Bristol CAFRA Workstream 3 (WS3) study, a Flood Modeller Pro (FMP)-TUFLOW model was developed (previously ISIS-TUFLOW), which was used and updated as part of the Bristol TFRMS project.

The WS3 model was retained to simulate a range of flood event scenarios, allowing for a full hydraulic linking between complex and numerous floodplain regions within Bristol.

FMP is a one-dimensional (1D) package used for modelling river channels, including bridges, culverts, weirs and other structures, calculating the varying water levels within the channel. TUFLOW is a two-dimensional (2D) hydraulic modelling package that simulates hydrodynamic behaviour of flood waters across the floodplain. Combining the two software packages is achieved through a hydraulic link to simulate the effects of channel flow entering the floodplain and vice versa at a grid resolution appropriate for ensuring that all flood mechanisms are accurately represented. This modelling software is widely used for modelling complex tidal and fluvial inundation scenarios and is considered as industry standard by the Environment Agency.

3.2 Issues and Limitations

A key shortcoming of the WS3 model is that the areas downstream of the Cumberland Basin, towards the Severn Estuary, are represented solely in 1D. Mapping flood risk within the Pill/Shirehampton area could therefore not be achieved through the same methodology as those areas within central Bristol such as the Floating Harbour which is represented using the 1D-2D method.

The primary limitation of the 1D setup downstream of Cumberland Basin, as opposed to the hydraulically linked 1D-2D representation further upstream in the Bristol City Centre, is that the model does not accurately represent the effects of raised defences at Pill/Shirehampton. As water rises up to the peak of a defence, the model results demonstrate that water is incorrectly shown to be already present behind the raised defences (where the landward side represents levels below the peak of the defence), i.e. before it spills over the peak of the defence. The outcome is therefore an overrepresentation of flood extent and depth. This is shown within the screenshot in **Figure 6**, which represents the cross-section (Av7_0705), defence height and high water level at Pill/Shirehampton during a 75 year tidal event (2015).

As the Pill/Shirehampton area is outside the primary focus area of central Bristol, and as the WS3 model has been signed off by the Environment Agency as appropriate for strategic representation of flood risk, a proportionate and pragmatic recommendation to improve the representation of flood risk in this area was put forward. The proposed approach involves digitally remove flooding from model results and mapping outputs which would otherwise demonstrate flooding in areas which are known to be sufficiently defended from specific return period events (under the Do Minimum and 'Do Something' options where gates are represented as closed). This is achieved by correcting the output results from the modelling runs for this area, using a GIS based approach. No modification is made to the simulated flood risk under the Do Nothing scenario (which assumes flood gates fail open) accepting the results are likely to provide a conservative worst case representation of flood risk for this 'hypothetical' scenario.

This proportionate approach follows industry accepted principles and is deemed suitable for this strategic level study and avoids significant financial and programme implications of more detailed modelling approaches which would provide only marginal additional benefit.

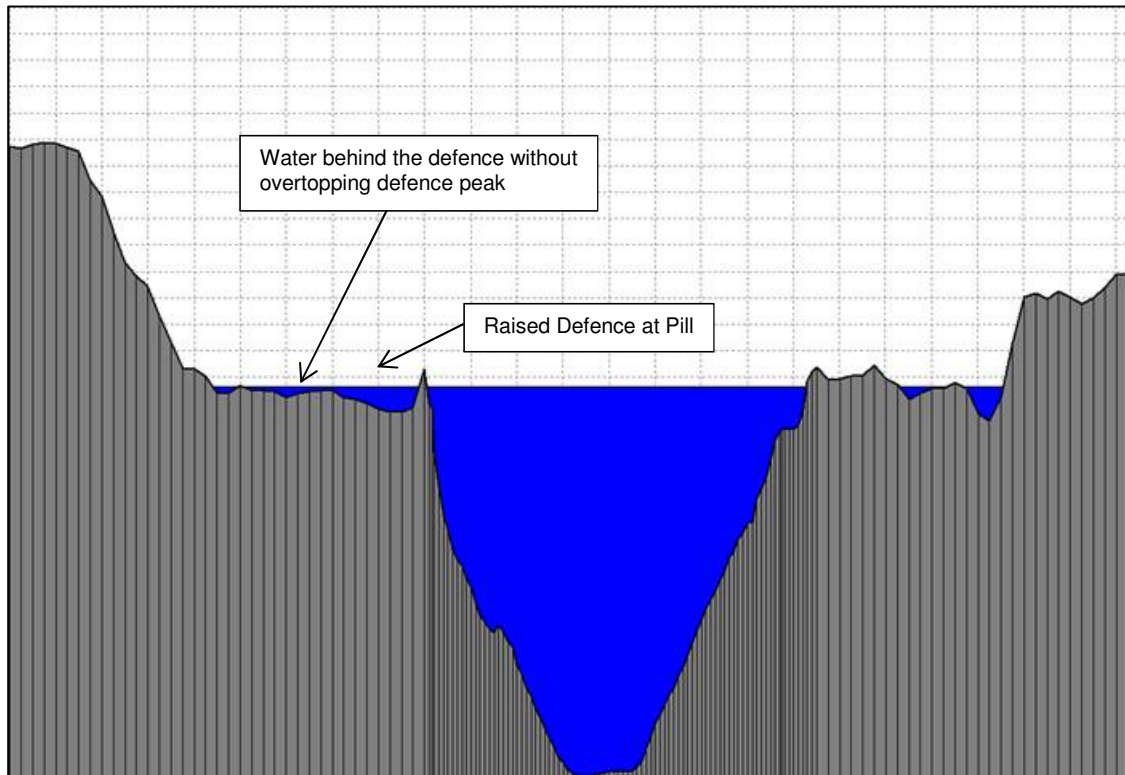


Figure 6 Pill/Shirehampton: One-Dimensional Cross-Section (FMP) (Av7_0705)

3.3

Mapping Methodology

To create an improved representation of flood extents a combination of available data, model simulation results and professional judgment were utilised and combined in a GIS based approach; the following methodology was applied to the Do Nothing, Do Minimum and Do Something scenarios. Figures produced using this approach are located within the appendices.

- LiDAR within the Pill/Shirehampton area was reviewed and then updated based on the present or future design crest height of local flood defences. For the Do Nothing scenario, defences were omitted as appropriate. For the Do Minimum scenario, the present day crest heights were retained. In some areas the LiDAR was manually updated in GIS where the flood defences had not been accurately represented. For the Do Something scenario, the LiDAR was updated to reflect the design crest height based on defence proposal and epoch.
- Maximum water levels were then extracted from the 1D FMP results for a range of cross sections that covered the Pill/Shirehampton area. This allowed for a maximum water level surface (TIN) to be created which defined how the flood level varied throughout the floodplain and surrounding area.
- The LiDAR DTM, was subtracted from the water surface TIN which allowed flood depth grids to be created. Tools within GIS were used to encompass all positive value which in turn led to the creation of flood extent polygons.
- Flood extents were then reviewed using professional judgment and then clipped using the LiDAR for the Do Nothing scenarios (i.e. using areas of higher ground to define the edge of the flood envelopes) and then using the flood defence crest heights (where applicable) for the Do Minimum and Do Something scenarios. 'Dry Islands' and disconnected areas (i.e. areas that become inundated behind the defence where water doesn't actually reach the defence height) were then removed.

Section 3.4 to Section 3.6 provides information regarding modelling results for both the Pill and Shirehampton areas, Do Nothing, Do Minimum and Do Something (Options Testing) scenarios respectively. Further limitations regarding final outputs are discussed in detail within Section 3.7.

3.4 Do Nothing

The Do Nothing scenario assumes all maintenance, repair and renewal work of existing flood defences, together with assets whose function influences flood risk, throughout the study area would cease immediately. With the 1D representation at Pill and Shirehampton it was not considered appropriate to make any changes to the LiDAR or flood defence crest height. As discussed above, the 1D model does not represent flood defence heights and flooding occurs behind the defence before the peak is overtopped, therefore no modifications to flood extents were required.

Figures showing the results from the Do Nothing scenario can be found within Appendix A. It should be noted that results are likely to provide an over representation of flood risk for this worst case 'hypothetical' scenario due to projection of peak flood levels across the Pill and Shirehampton floodplain. This is discussed in more detail within Section 3.7.

The results show that for each scenario, when defences are removed and flood gates are not in operation, Pill and Shirehampton become inundated by floodwater during each of the return period events simulated (from the 2 year tidal event (2015) up to the 1000 year tidal event (2115)). At Pill, properties along Marine Parade, Mariner's Way, Underbanks and Watch House Road first become inundated during the 2 year tidal event (2015) however as the magnitude of the event increases, so does the extent and depths of flooding. During the higher return periods (from the 75 year tidal event (2015) up to the 1000 year tidal event (2115)) flooding occurs further south in areas where the Markham Brook is culverted, with properties along Ham Green, Heywood Road, Bank Street and Pill Street also inundated.

With Shirehampton, properties along Wellington Mews, Station Road and Nibley Road are shown to be inundated by floodwater during the lowest return period (2 year tidal event, 2015) and as the magnitude of the event increase, flooding extends north and east causing greater flood depths in properties within these areas.

3.5 Do Minimum

The Do Minimum scenario represents what would likely happen under the 'status quo' i.e. if the continuation of current investment was provided to maintain existing flood defence structures for the duration of the Strategy (2015-2115). This scenario does not consider an improvement in performance of existing structures over time, nor does it consider maintenance which would result in an increase in the existing standard of protection. Flood gates are assumed to be in the closed position under this scenario.

From a review of the LiDAR there were some areas within Pill and Shirehampton where defence heights were not recognised due to model resolution. The LiDAR was therefore modified to ensure that defences were being recognised allowing more accurate flood extents to be produced. **Figure 7** shows the location of the flood defences along with the crest heights that were updated into the LiDAR. These were based on survey information provided by BCC combined with review of available LiDAR. The defence heights are also shown within **Table 9**.

Table 9 also provides a Standard of Protection (SoP) for each flood defence for each Epoch. This is based on the lowest crest height associated with each defence type and looks only at the return periods (1 in 20, 1 in 75, 1 in 100, 1 in 200 and 1 in 1000) that have been associated within this assessment. Some defences may have a SoP that is in-between return periods, however without this information this cannot be specified at this time.

Table 9: Defence Information

Place	Defence Location	Crest Height of Defence (m AOD)	Standard of Protection			
			2015	2030	2065	2115
Pill	Earth Embankment	9.61 – 9.93	1 in 1000	1 in 1000	1 in 200	1 in 20
	Sheet Piled Wall (Marine Parade)	9.32	1 in 200	1 in 200	1 in 100	< 1 in 20
	Sheet Piled Wall (Underbanks)	9.31 – 9.56	1 in 200	1 in 200	1 in 75	< 1 in 20
	Bank Height (Watch House Road)	7.61 – 8.19	< 1 in 20	< 1 in 20	< 1 in 20	< 1 in 20
	Embankment	9.31 – 9.36	1 in 200	1 in 200	1 in 75	< 1 in 20
	Flood Gate (North)	9.44 (7.56m AOD Sill Level)	1 in 200	1 in 200	1 in 100	1 in 20
	Flood Gate (South)	9.37 (7.98m AOD Sill Level)	1 in 200	1 in 200	1 in 100	< 1 in 20
Shirehampton	Earth Embankment (west)	8.85 – 9.33	1 in 20	1 in 20	< 1 in 20	< 1 in 20
	Masonry Wall (Station Road)	9.25 – 9.27	1 in 200	1 in 200	1 in 20	< 1 in 20
	Earth Embankment (Station Road)	9.14 – 9.20	1 in 200	1 in 100	1 in 20	< 1 in 20
	Bank Height (east)	9.14 – 9.43	1 in 200	1 in 100	1 in 20	< 1 in 20
	Flood Gate (Sea Cadets Compound)	n/a (infilled)	n/a	n/a	n/a	n/a
	Flood Gate (Shirehampton Sea)	9.28 (8.24m AOD Sill Level)	1 in 200	1 in 200	1 in 75	< 1 in 20

Table 10 provides an overview of the results for each epoch identifying where overtopping of flood defences occurs and for which return period. Figures showing these results can be found in Appendix B.

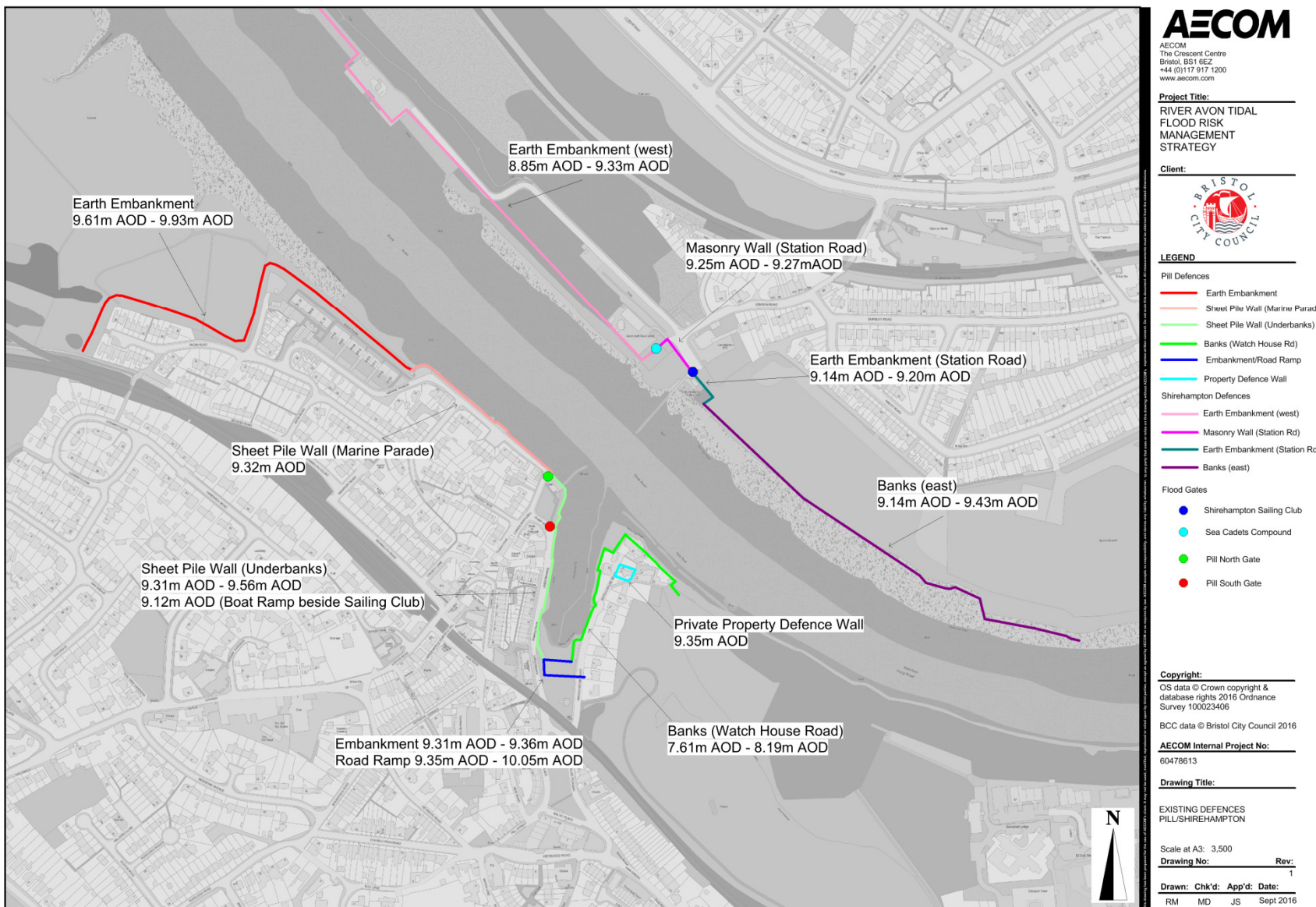


Figure 7 Existing Flood Defences

Table 10: Do Minimum Results

Epoch	Return Period Event	Flooding at Pill	Flooding at Shirehampton
2015	2 yr	Majority of Pill remains free from floodwater. The only exception is along Watch House Road where water overtops the right bank of the Crockerne Pill and inundates several properties.	No overtopping of defences.
	20 yr		
	75 yr		
	200 yr	The earth embankment to the west and the sheet pile wall along Underbanks both overtop meaning the area behind (Mariner's Way and Marine Parade) are shown to be inundated by floodwater. Flooding is also shown to occur along Ham Green, Heywood Road, Baltic Place and Bank Place which coincides with the location of the Markham Brook (culverted).	Defences overtop inundating the area adjacent to the River Avon which includes properties along Wellington Mews, Station Road and Nibley Road.
	1000 yr		
2030	2 yr	Majority of Pill remains free from floodwater. The only exception is along Watch House Road where water overtops the right bank of the Crockerne Pill and inundates several properties.	No overtopping of defences.
	20 yr		
	75 yr	NO RESULTS AVAILABLE TO MAKE ASSESSMENT	
	200 yr	Majority of Pill remains free from floodwater. The only exception is along Watch House Road where water overtops the right bank of the Crockerne Pill and inundates several properties.	Defences overtop inundating the area adjacent to the River Avon which includes properties along Wellington Mews, Station Road and Nibley Road.
	1000 yr	The earth embankment to the west and the sheet pile wall along Underbanks both overtop meaning the area behind (Mariner's Way and Marine Parade) are shown to be inundated by floodwater. Flooding is also shown to occur along Ham Green, Heywood Road, Baltic Place and Bank Place which coincides with the location of the Markham Brook (culverted).	Defences overtop inundating the area adjacent to the River Avon which includes properties along Wellington Mews, Station Road and Nibley Road. Overtopping occurs behind properties along Nibley Road in new location.

2065	2 yr	Majority of Pill remains free from floodwater. The only exception is along Watch House Road where water overtops the right bank of the Crockerne Pill and inundates several properties.	No overtopping of defences.
	20 yr	NO RESULTS AVAILABLE TO MAKE ASSESSMENT	
	75 yr	Majority of Pill remains free from floodwater. The only exception is along Watch House Road where water overtops the right bank of the Crockerne Pill and inundates several properties.	Defences overtop inundating the area adjacent to the River Avon which includes properties along Wellington Mews, Station Road and Nibley Road.
	200 yr	The earth embankment to the west and the sheet pile wall along Underbanks both overtop meaning the area behind (Mariner's Way and Marine Parade) are shown to be by floodwater. Flooding is also shown to occur along Ham Green, Heywood Road, Baltic Place and Bank Place which coincides with the location of the Markham Brook (culverted).	Defences overtop inundating the area adjacent to the River Avon which includes properties along Wellington Mews, Station Road and Nibley Road. Overtopping occurs behind properties along Nibley Road.
	1000 yr		
2115	2 yr	Majority of Pill remains free from floodwater. The only exception is along Watch House Road where water overtops the right bank of the Crockerne Pill and inundates several properties.	No overtopping of defences.
	20 yr	The earth embankment to the west and the sheet pile wall along Underbanks both overtop meaning the area behind (Mariner's Way and Marine Parade) are shown to be inundated by floodwater. Flooding is also shown to occur along Ham Green, Heywood Road, Baltic Place and Bank Place which coincides with the location of the Markham Brook (culverted).	Defences overtop inundating the area adjacent to the River Avon which includes properties along Wellington Mews, Station Road and Nibley Road. Overtopping occurs behind properties along Nibley Road. As the magnitude of the return period increases, the depths and flood extents both increase.
	75 yr	The earth embankment to the west and the sheet pile wall along Underbanks both overtop meaning the area behind (Mariner's Way and Marine Parade) are shown to be inundated by floodwater. Flooding is also shown to occur along Ham Green, Heywood Road, Baltic Place and Bank Place which coincides with the location of the Markham Brook (culverted). As the magnitude of the return period increases, the depths and flood extents both increase.	
	200 yr		
	1000 yr		

It should be noted that a reasonable assumption has been made in that all defences are maintained to the crest heights specified within Table 9. However, Atkins' Stability and Durability of Pill Sheet Pile Wall (2012) has concluded that a section of Underbanks river bank is below the required level to ensure the design capacity of the system is not exceeded and the erosion assessment estimated that this would extend to the full length of the wall within 20 years, with mitigation works required. The report also concludes that corrosion losses mean the sheet piles have approximately 40 years residual life.

3.6 Do Something (Option Testing)

Following the results from the Do Nothing and Do Minimum results, a number of strategic options were identified from a long list of thirty-nine options to reduce flood risk within Bristol. For each strategic option, a 'measure' was assigned to each time epoch, for instance one of the strategic options suggests Property Level Protection (PLP) in the short term (2015-2030), implementing Low Defences in the medium term (2030-2065) and then raising these defences to High Defences in the long term (2065-2115). For the purpose of the appraisal, it has been assumed that the measure for each time epoch will be constructed / implemented at the start of each time epoch.

As part of this report, low defences and high defences have been tested to see whether new proposed defences can reduce flooding within both Pill and Shirehampton. The crest heights for defences in each location are as follows and are shown in **Figure 8 and Figure 9**:

- Low Defences (2015) = Pill: 9.34m AOD and Shirehampton: 9.34m AOD
- Low Defences (2030) = Pill: 9.42m AOD and Shirehampton: 9.42m AOD
- High Defences (2115) = Pill: 10.03m AOD and Shirehampton 10.18m AOD

Below there are two tables (**Table 11 – 12**) which provide more information regarding the defences at both Pill and Shirehampton (**Figure 7**). Each table provides the existing defence heights (the lowest crest level taken for each defence type to represent a worst case scenario), the average ground level behind each defence taken from LiDAR, the proposed defence height for each defence at each Epoch and the height increase/height from ground. It should be noted that there is limited information associated with the existing defences therefore the lowest provided crest level has been considered along with an average ground level from LiDAR. It is therefore likely that the height of the wall from ground and the height that the existing defences need to be raised may be different to the results within Table 11 and 12.

Results for Pill show that when the low and high defences are implemented, they offer a level of protection up to and including the 200 year tidal event (2115) with no overtopping occurring (Appendix C). This includes the area along Watch House Road which originally became inundated under all return periods (from the 2 year tidal event (2015) up to the 1000 year tidal event (2115)) under the Do Minimum Scenario.

In Shirehampton, the masonry wall near Station Road does not overtop when the low defences are in place, however by applying the GIS approach, the maximum water level at this location is greater than the ground level behind the defence, and therefore this area is shown to be flooded. With overtopping of the earth embankment occurring further downstream, it is possible that water circumvents the immediate defences by overtopping elsewhere and is conveyed overland to the residential areas within Shirehampton, behind the Station Road defences. While this is unlikely given the location and level of overtopping, it cannot be dismissed at this stage without more detailed 2D representation of the area (or topographic survey information) to allowing further understanding of floodwater propagation. This is discussed in more detail within Section 3.7.

With respect to the high defences, a similar situation is experienced for the 200 year event (2015 and 2115) with no overtopping of the Station Road defences; however the earth embankment further downstream is overtopped which could be linked to flooding within Shirehampton (as discussed above).

Table 11: Defence Information - Pill

Defence	Ground level behind defence (m AOD) - LiDAR	Existing defence height (m AOD)	Epoch	Proposed defence height (m AOD)	Height existing defence needs to be raised (m)	Proposed defence height from ground (m)
Earth Embankment	8.60	9.61	2015	n/a	n/a	n/a
			2030	n/a	n/a	n/a
			2115	10.03	+ 0.43	1.70
Sheet Pile Wall (Marine Parade)	7.90	9.32	2015	9.34	+ 0.02	1.44
			2030	9.42	+ 0.10	1.52
			2115	10.03	+ 0.71	2.13
Sheet Pile Wall (Underbanks)	7.90	9.31	2015	9.34	+ 0.03	1.44
			2030	9.42	+ 0.11	1.52
			2115	10.03	+ 0.72	2.13
Embankment (Underbanks)	8.10	9.31	2015	9.34	+ 0.03	1.24
			2030	9.42	+ 0.11	1.32
			2115	10.03	+ 0.72	1.93
Banks (Watch House Rd)	7.89	7.61	2015	9.34	+ 1.73	1.45
			2030	9.42	+ 1.81	1.53
			2115	10.03	+ 2.42	2.14
Private Property Defence Wall	8.13	9.35	2015	n/a	n/a	n/a
			2030	9.42	+ 0.07	1.29
			2115	10.03	+ 0.68	1.90

Where a cell reads n/a, it means that the existing defence is already greater than the proposed defence height

Table 12: Defence Information - Shirehampton

Defence	Ground level behind defence (m AOD) - LiDAR	Existing defence height (m AOD)	Epoch	Proposed defence height (m AOD)	Height existing defence needs to be raised (m)	Proposed defence height from ground (m)
Earth Embankment (West)	8.76	8.85	2015	9.34	+ 0.49	0.58
			2030	9.42	+ 0.57	0.66
			2115	10.18	+ 1.33	1.42
Masonry Wall (Station Road)	8.20	9.25	2015	9.34	+ 0.09	1.14
			2030	9.42	+ 0.17	1.22
			2115	10.18	+ 0.93	1.98
Earth Embankment (Station Road)	8.20	9.14	2015	9.34	+ 0.20	1.14
			2030	9.42	+ 0.28	1.22
			2115	10.18	+1.04	1.98
Banks (east)	8.20 (rises to 9.50)	9.14	2015	9.34	+ 0.20	1.14
			2030	9.42	+ 0.28	1.22
			2115	10.18	+ 1.04	1.98

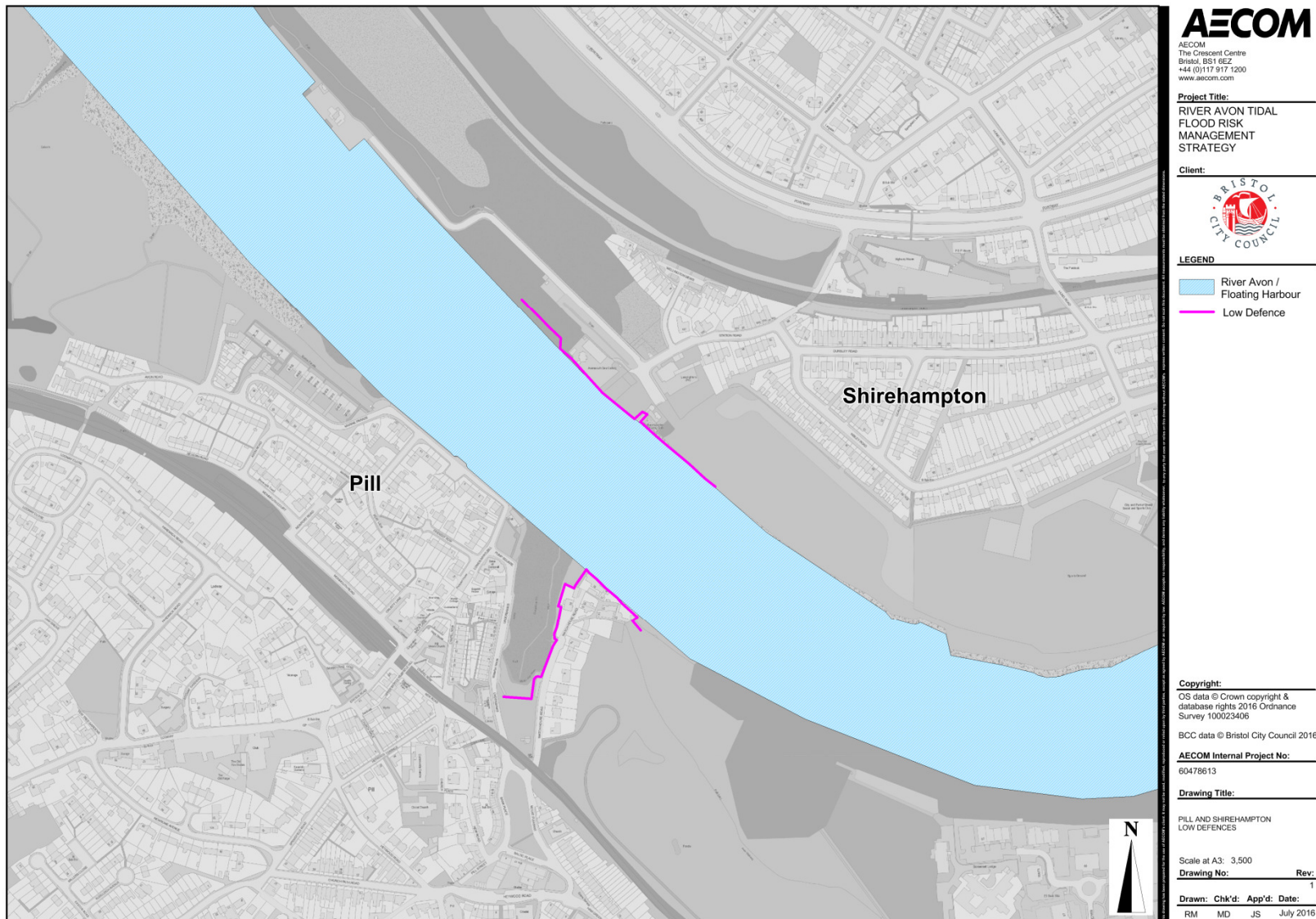


Figure 8 Pill/Shirehampton Low Defences

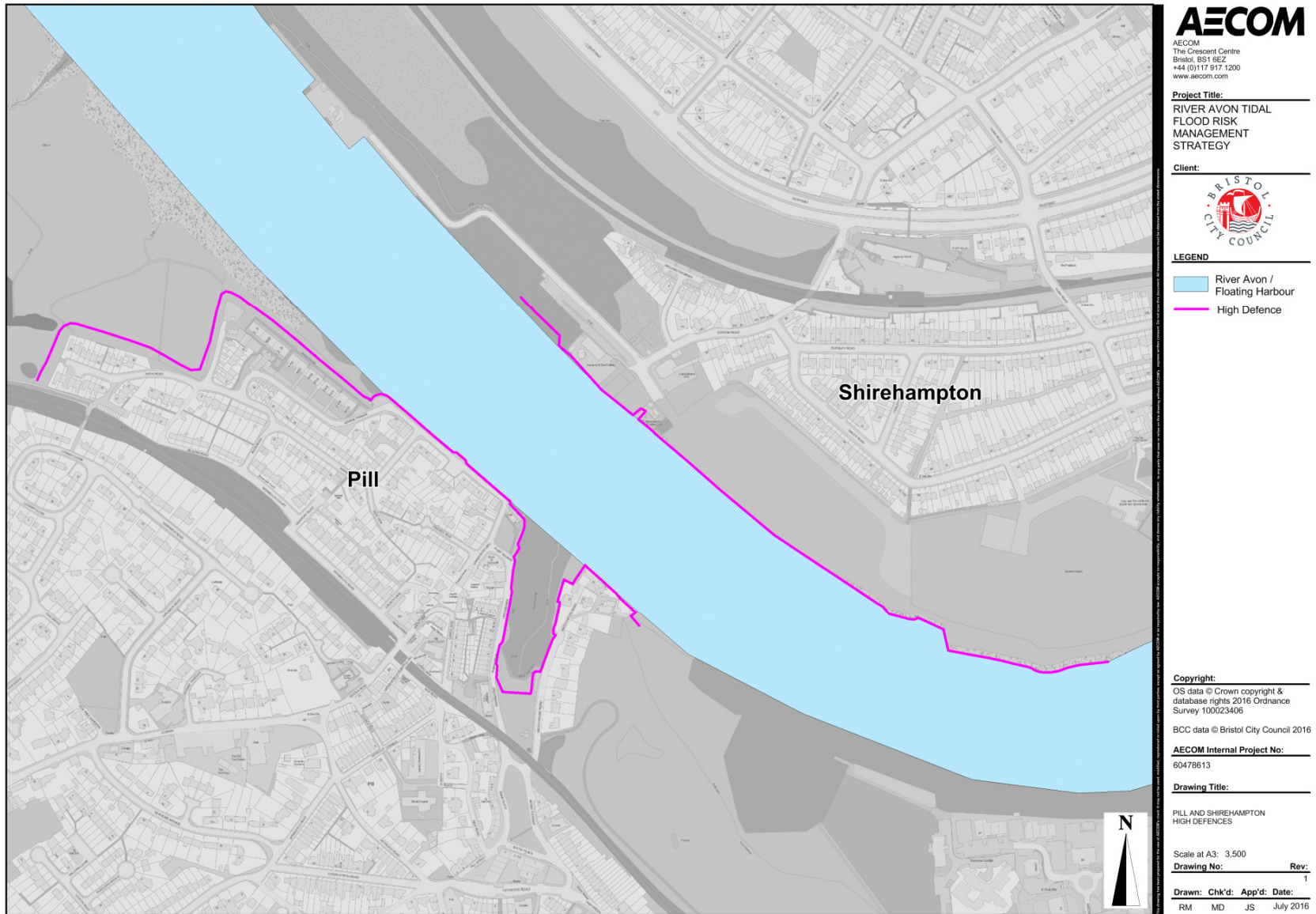


Figure 9 Pill/Shirehampton High Defences

3.7 1D Mapping Limitations

The 1D mapping approach is useful in determining whether defences are overtopped; however there are significant limitations when considering the flood depths and extents. Through subtracting the LiDAR from the water surface TIN, it is easy to see where the flood extent becomes disconnected i.e. separated by a raised defence, and therefore it is safe to assume that in reality, flooding is unlikely to occur in that particular area. An example of this is shown in **Figure 10**.

Figure 10 clearly shows the location of the earth embankment and sheet pile wall running adjacent to the watercourse along Marine Parade. Where no flood depths are shown along each of the defences, it is safe to assume that neither defence are overtopped during the simulated flood event, even though floodwater is located behind the defence (**Figure 6** – showing the Pill/Shirehampton cross-section, Av7_0705). Through the GIS based approach, this area of flooding has been removed, because in reality this area does not flood.

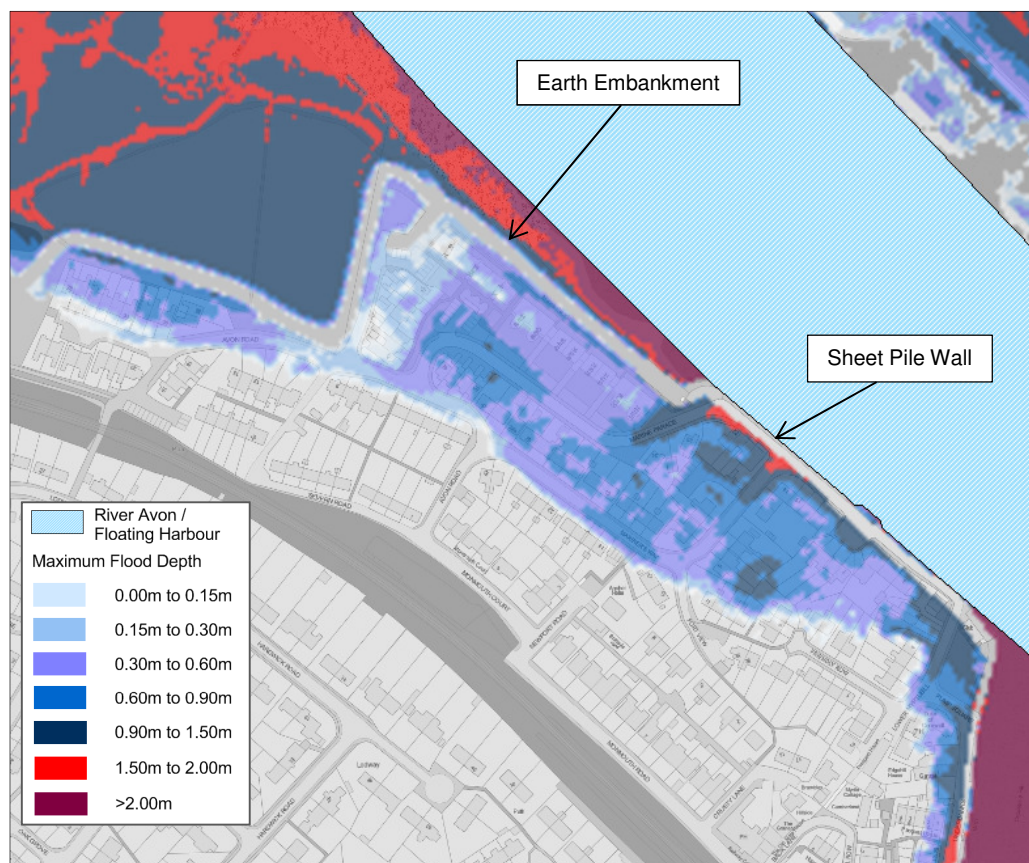


Figure 10 Pill Flood Defences (Do Minimum – 75 year tidal event, 2015)

During greater return periods than shown in **Figure 10**, the flood defences in Pill do become overtopped (as shown in **Table 10**) and this leads to the main limitations associated with this approach. For example, during the 1000 year event (2030) the maximum water level within the channel is ~9.58m AOD and would therefore overtop the defences within Pill which are ~9.32m AOD (**Figure 11**). However, as the 1D mapping approach involves simply subtracting the LiDAR from the water surface TIN, water propagation is not taken into consideration and therefore water depths and extents are likely to be far greater than they may be in reality. In this instance, depths of up to 2m are experienced in areas of Pill behind the defence which is unlikely given that in some areas, the defences are only just overtopped.

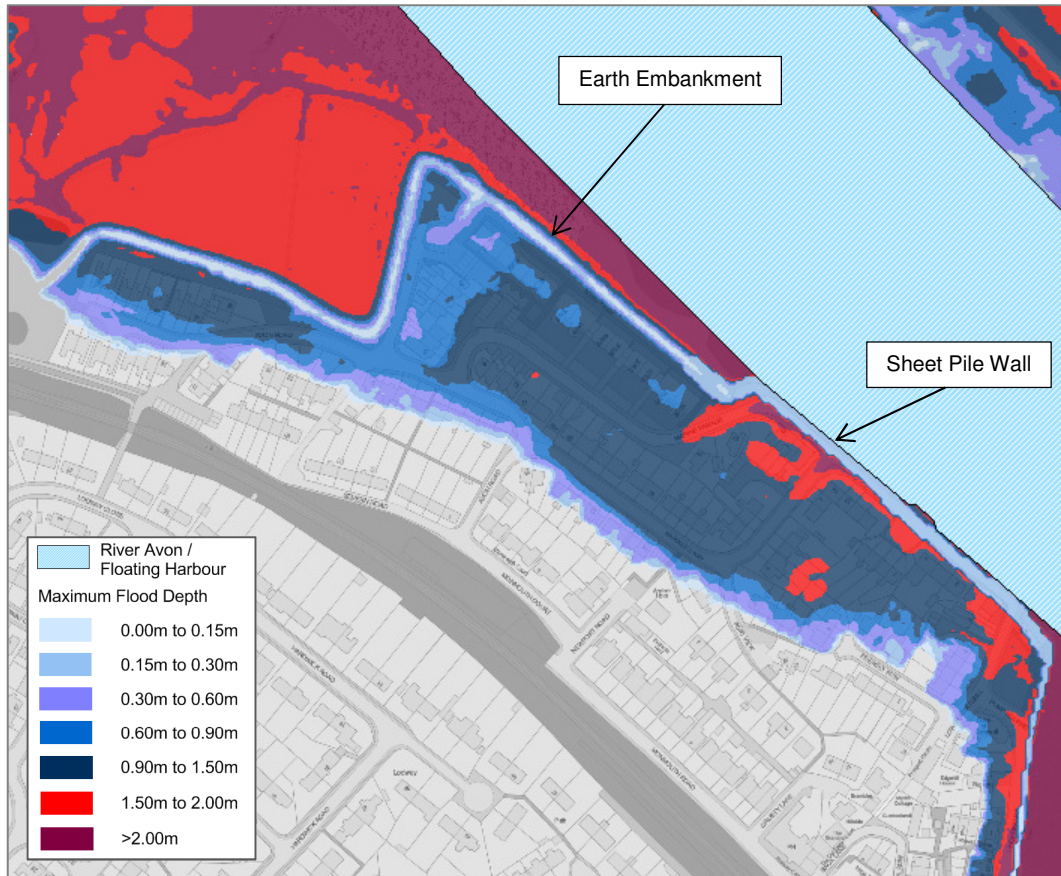


Figure 11 Pill Flood Defences (Do Something – 1000 year event, 2030)

A second example emphasising this issue is from the 200 year event (2015) with the proposed Low Defences installed along the River Avon in Shirehampton (**Figure 12**). Similar to the example above, results show that the masonry wall near Station Road does not overtop and in theory, the properties located behind should be protected. However, by subtracting the LiDAR from the water surface TIN, this area is shown to be inundated by floodwater as ground levels in this area are lower than the maximum water level.

Through adopting the GIS based approach, this area of flooding could be removed however, through a review of the wider area, results show that the earth embankment further downstream is overtopped. Without the 2D representation within this area, flowpaths are unknown and therefore it is not considered appropriate to modify the flood extents without further information on water propagation. This is due to overtopping downstream which may be the flood mechanism which results in flooding within the residential area.

Based on these results it is possible that flooding may not occur within the Shirehampton area (along Wellington Mews, Station Road and Nibley Road) when the new defences are implemented, but without more detailed modelling, this cannot be concluded with full confidence.

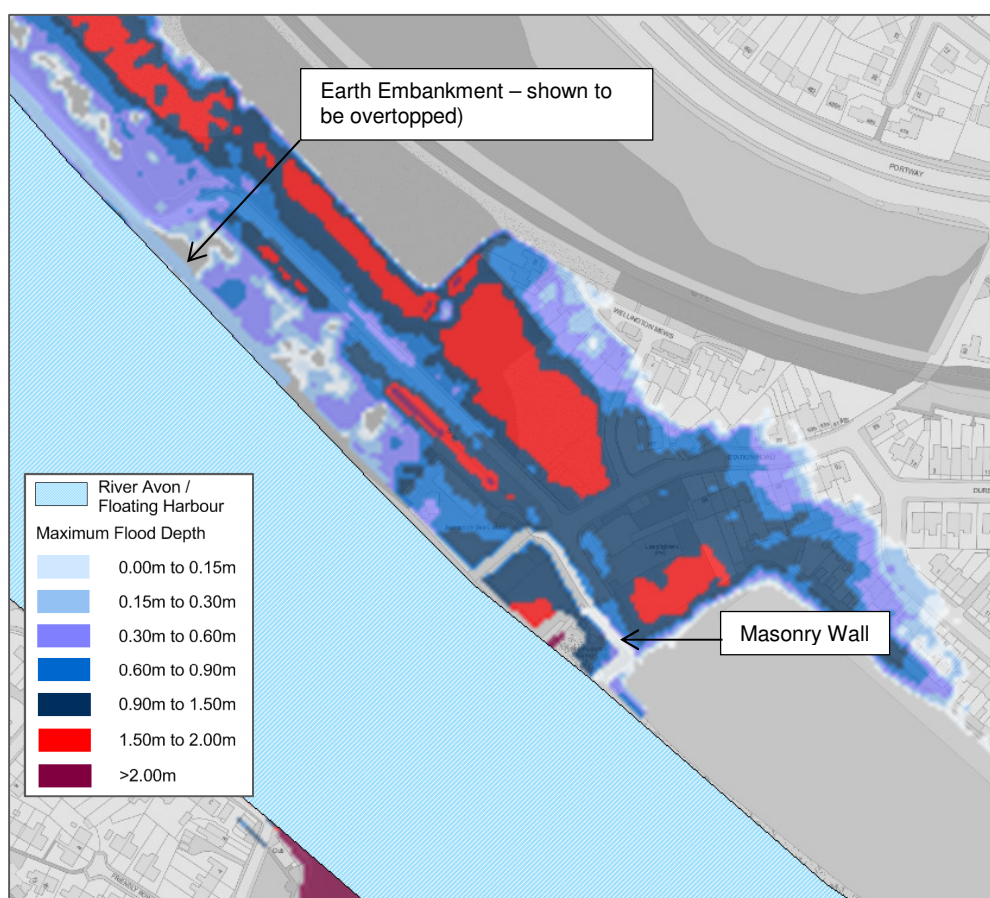


Figure 12 Shirehampton Flood Defences (Do Something – 200 year event, 2015)

3.8 Fluvial Flood Risk

As part of this report, fluvial flood risk was also investigated to assess the level of risk to Pill from the Markham Brook. According to the Markham Brook, Pill – Standard of Protection Study (undertaken in 2012 by the Environment Agency), it was concluded that there is very little risk of flooding in Pill from fluvial sources. The fire station is potentially at risk from a 1 in 10 year fluvial flood (combined with a Mean High Water Spring (MHWS) tide) and an estimated 3 properties immediately upstream of the pumping station are considered to be at risk from a 1 in 100 year fluvial event (combined with a MHWS tide).

It should be noted that this assessment was carried out using a 1D model and therefore more accurate results could be produced with 2D representation of the floodplain, similar to earlier discussions within this report.

Based on the results from this study and a review of the Markham Brook location, tidal flood risk is considered to be the dominant source of flood risk to Pill, with a reduced relative risk from fluvial sources.

3.9 Summary of updates

Table to Table 10 present the number of properties at Pill and Shirehampton at risk from various return period events before and after the updates. The tables demonstrate that the updated at Pill and Shirehampton have significantly reduced the number of properties at risk in the economics assessment. The change in Do Minimum economic damages at Pill and Shirehampton resulting from the update is a reduction in PV damages of approximately £81million.

Table 12 **Total Numbers of properties at risk at Pill and Shirehampton prior to the updates being undertaken (Do Minimum scenario). The numbers of residential properties (Res) and Commercial properties (Com) are shown.**

Year	Return period				
	1:2yr	1:20yr	1:75yr	1:200yr	1:1000yr
2015	72 Res: 64 Com: 8	177 Res: 160 Com: 17	215 Res: 197 Com: 18	244 Res: 225 Com: 19	276 Res: 257 Com: 19
2030	98 Res: 89 Com: 9	192 Res: 175 Com: 17	220 Res: 202 Com: 18	259 Res: 240 Com: 19	285 Res: 266 Com: 19
2065	170 Res: 154 Com: 16	220 Res: 202 Com: 18	263 Res: 244 Com: 19	276 Res: 257 Com: 19	311 Res: 291 Com: 20
2115	224 Res: 205 Com: 19	273 Res: 254 Com: 19	304 Res: 284 Com: 20	328 Res: 308 Com: 20	359 Res: 338 Com: 21

Table 9 **Numbers of properties at risk at Pill and Shirehampton after the updates (Do Minimum scenario). The numbers of residential properties (Res) and Commercial properties (Com) are shown.**

Year	Return period				
	1:2yr	1:20yr	1:75yr	1:200yr	1:1000yr
2015	5 Res: 5 Com: 0	7 Res: 7 Com: 0	7 Res: 7 Com: 0	56 Res: 54 Com: 2	276 Res: 257 Com: 19
2030	6 Res: 6 Com: 0	7 Res: 7 Com: 0	0 Res: 0 Com: 0	60 Res: 58 Com: 2	284 Res: 265 Com: 19
2065	7 Res: 7 Com: 0	0 Res: 0 Com: 0	61 Res: 59 Com: 2	276 Res: 257 Com: 19	310 Res: 290 Com: 20
2115	7 Res: 7 Com: 0	273 Res: 254 Com: 19	303 Res: 283 Com: 20	325 Res: 305 Com: 20	356 Res: 336 Com: 20

Table 10 **Changes in numbers of properties at risk at Pill and Shirehampton (Do Minimum scenario). The numbers of residential properties (Res) and Commercial properties (Com) are shown.**

Year	Return period				
	1:2yr	1:20yr	1:75yr	1:200yr	1:1000yr
2015	-67	-170	-208	-188	0
	Res: -59 Com: -8	Res: -153 Com: -17	Res: -190 Com: -18	Res: -171 Com: -17	Res: 0 Com: 0
2030	-92	-185	-220	-199	-1
	Res: -83 Com: -9	Res: -168 Com: -17	Res: -202 Com: -18	Res: -182 Com: -17	Res: -1 Com: 0
2065	-163	-220	-202	0	-1
	Res: -147 Com: -16	Res: -202 Com: -18	Res: -185 Com: -17	Res: 0 Com: 0	Res: -1 Com: 0
2115	-217	0	-1	-3	-3
	Res: -198 Com: -19	Res: 0 Com: 0	Res: -1 Com: 0	Res: -3 Com: 0	Res: -2 Com: -1

3.10

Conclusion

Without modelling the study areas in 2D it is difficult to accurately map flood extents and depths due to significant 1-D modelling limitations. While the approach adopted provides a useful indication of where defences are overtopped, there are significant uncertainties with respect to flood extents and depths where overland flood propagation is unknown. Where flood extents have not been modified it should be noted that these represent a worst case scenario and it is likely that depths and extents are considered to be conservative.

While the results from the Do Something scenario show Pill to be protected up to and including the 200 year event (2115), there remains a question as to the level of protection and subsequent flood risk associated with Shirehampton which may require further assessment of the flood defences within this area. It is recommended that if more detailed appraisals are undertaken for potential schemes within this area, the recommendations documented within this report should be taken forward, where increased representation of overland flow paths through 1D-2D modelling would provide a greater confidence in flood risk.

4**REFERENCES**

Arup (2016) River Avon Tidal De Facto Flood Defences Investigation Visual Walkover Structural Assessment

Atkins (2012) Stability and Durability Assessment of Pill Sheet Pile Wall

Hyder (2015) Verification of CAFRA model against 2014 tides. Report 5007-UA007571-UU41-2.0

5.1 Appendix A: Pill / Shirehampton Do Nothing Flood Maps

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:



LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m

Model Reference:

CAFRA_134_2yr_FBASE_T002_2015

Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

PILL & SHIREHAMPTON
RUN ID 1 - DO NOTHING
2 YR RETURN PERIOD
2015
MAXIMUM FLOOD DEPTH

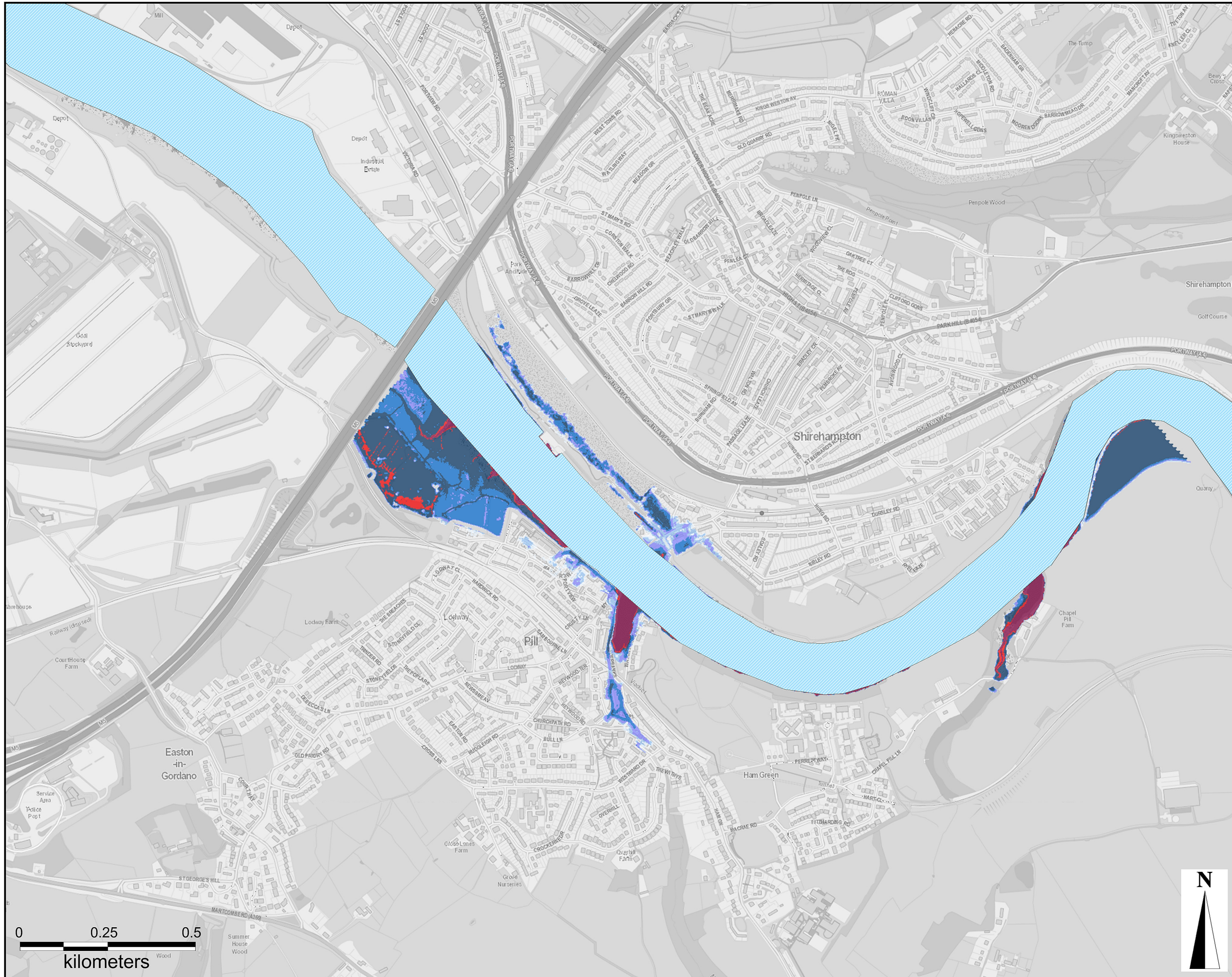
Scale at A3: 10,200

Drawing No: **Rev:**

FIGURE A-1 **1**

Drawn: Chk'd: App'd: **Date:**

RM MD JS June 2016



This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM, except as required by law. AECOM accepts no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:



LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m

Model Reference:

CAFRA_134_20yr_FBAS_T020_2015

Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

PILL & SHIREHAMPTON
RUN ID 2 - DO NOTHING
20 YR RETURN PERIOD
2015
MAXIMUM FLOOD DEPTH

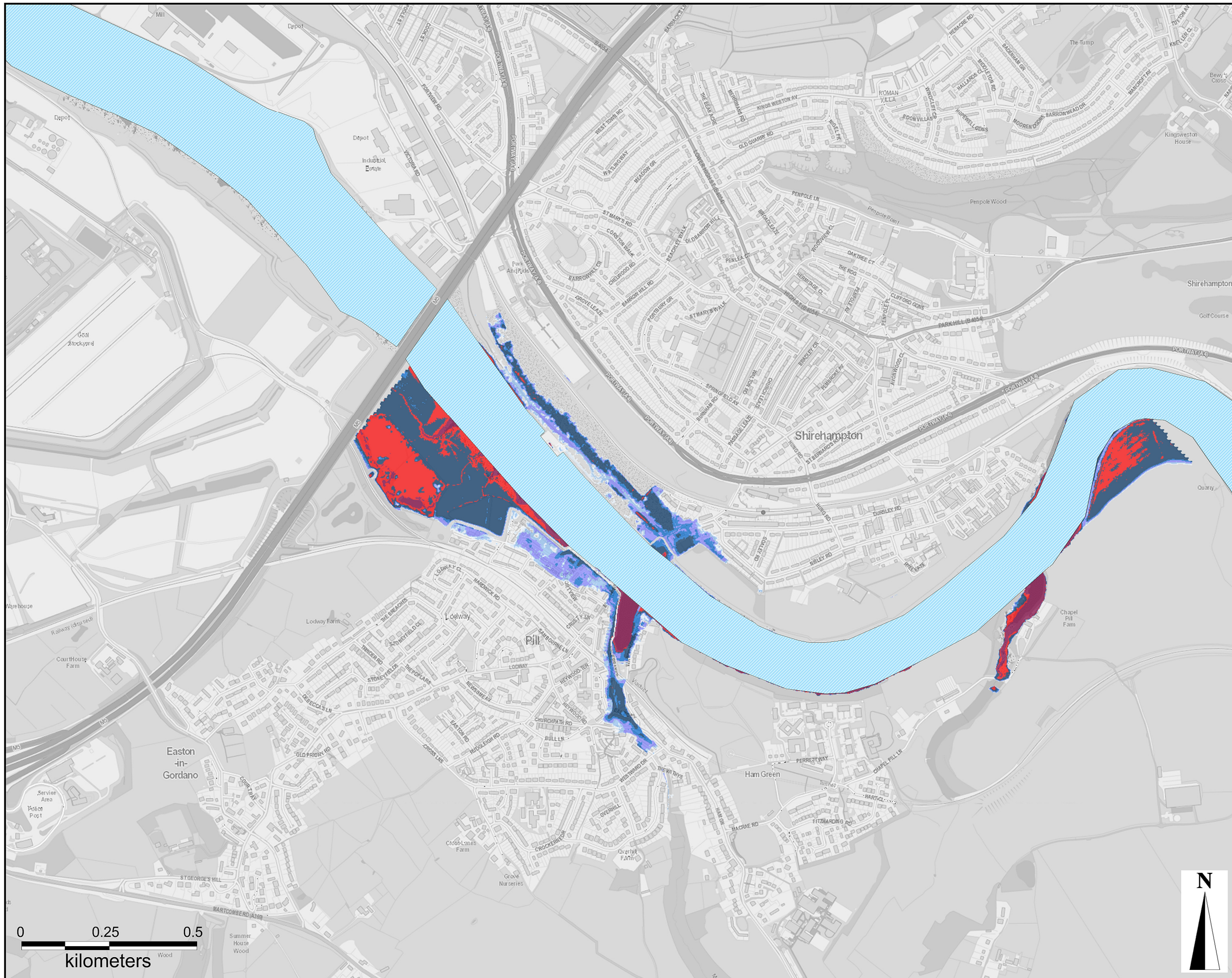
Scale at A3: 10,200

Drawing No: **Rev:**

FIGURE A-2 1

Drawn: Chk'd: App'd: **Date:**

RM MD JS June 2016



This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM in writing. AECOM accepts no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:



LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m

Model Reference:

CAFRA_134_75yr_FBASE_T075_2015

Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

PILL & SHIREHAMPTON
RUN ID 3 - DO NOTHING
75 YR RETURN PERIOD
2015
MAXIMUM FLOOD DEPTH

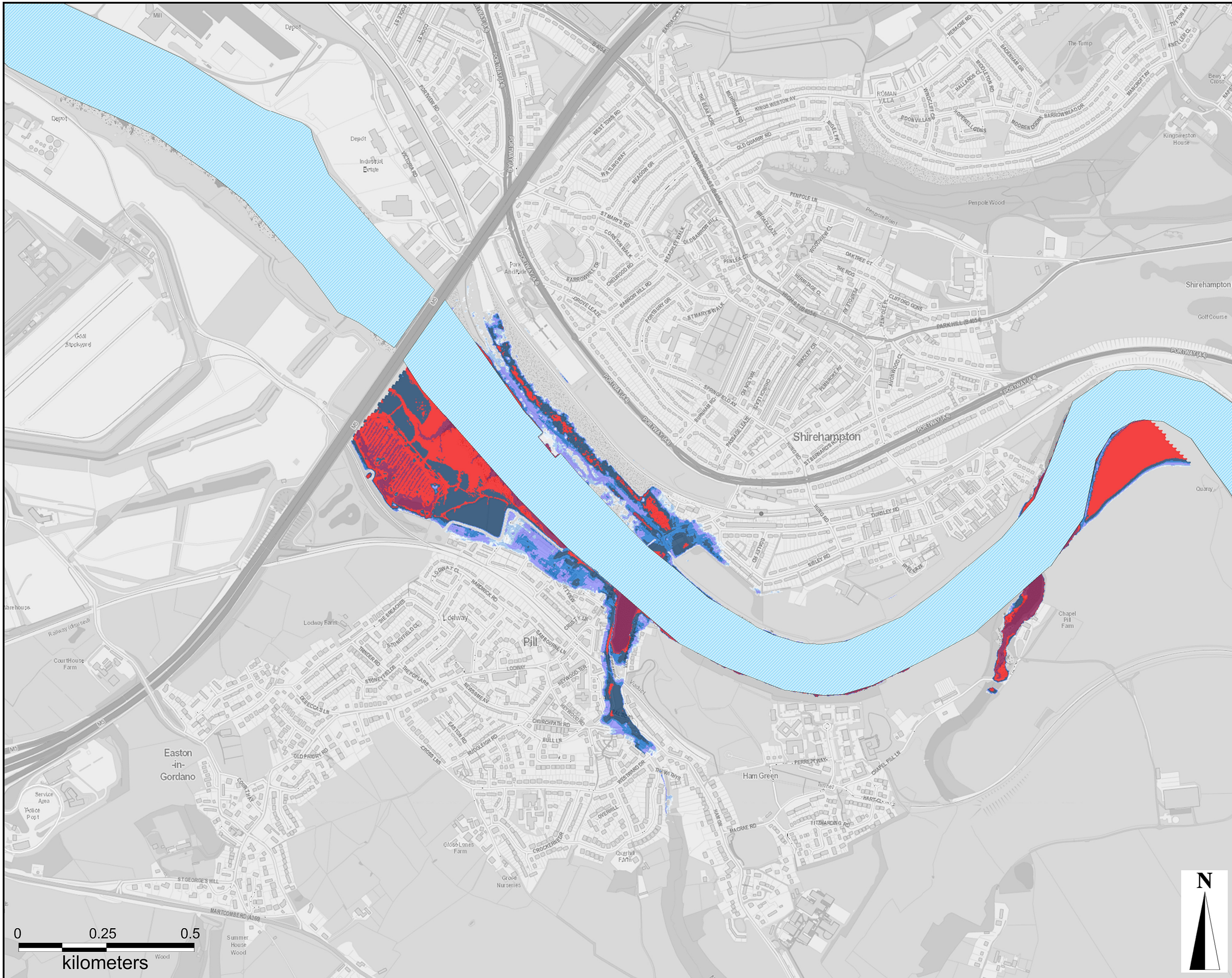
Scale at A3: 10,200

Drawing No: **Rev:**

FIGURE A-3 1

Drawn: Chk'd: App'd: **Date:**

RM MD JS June 2016



This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM, accept no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:



LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m

Model Reference:

CAFRA_134_200yr_F002_T200_2015

Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

PILL & SHIREHAMPTON
RUN ID 4 - DO NOTHING
200 YR RETURN PERIOD
2015
MAXIMUM FLOOD DEPTH

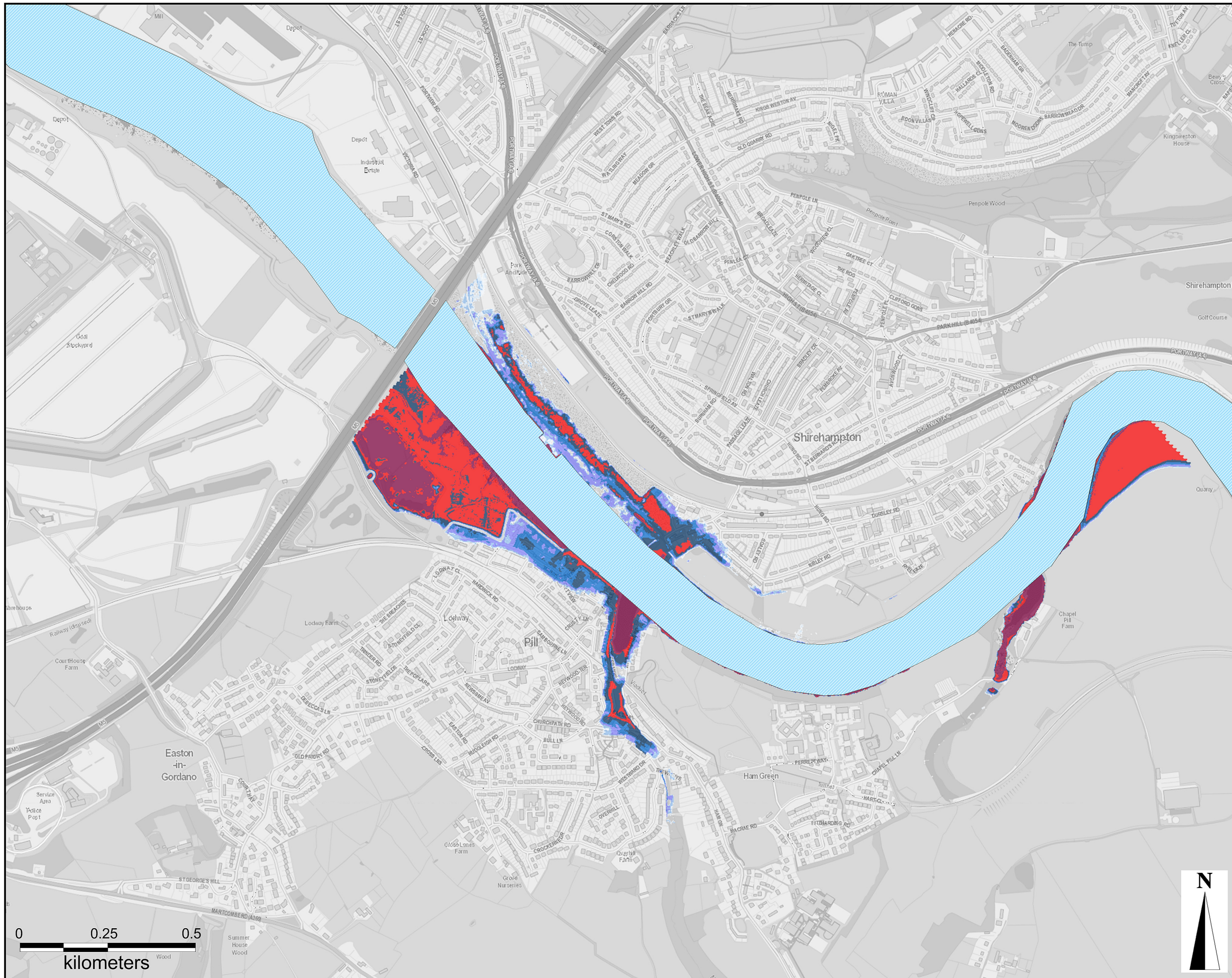
Scale at A3: 10,200

Drawing No: **Rev:**

FIGURE A-4 **1**

Drawn: Chk'd: App'd: **Date:**

RM MD JS June 2016



This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM. AECOM accepts no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:



LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m

Model Reference:

CAFRA_134_1000yr_F012_T1000_2015

Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

PILL & SHIREHAMPTON
RUN ID 5 - DO NOTHING
1000 YR RETURN PERIOD
2015
MAXIMUM FLOOD DEPTH

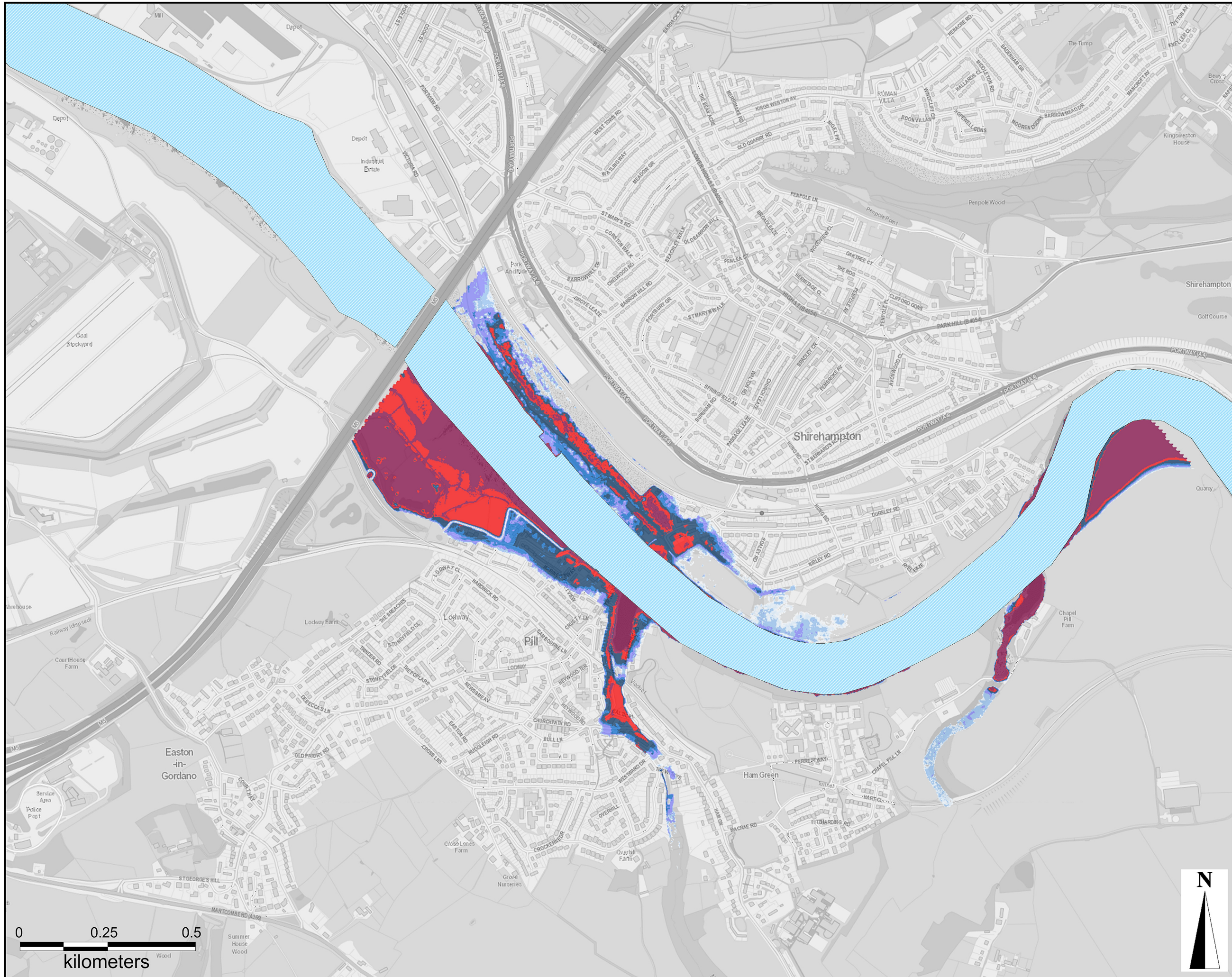
Scale at A3: 10,200

Drawing No: **Rev:**

FIGURE A-5 1

Drawn: Chk'd: App'd: **Date:**

RM MD JS June 2016



This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM. AECOM accepts no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:



LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m

Model Reference:

CAFRA_134_2yr_FBASE_T002_2030

Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

PILL & SHIREHAMPTON
RUN ID 6 - DO NOTHING
2 YR RETURN PERIOD
2030
MAXIMUM FLOOD DEPTH

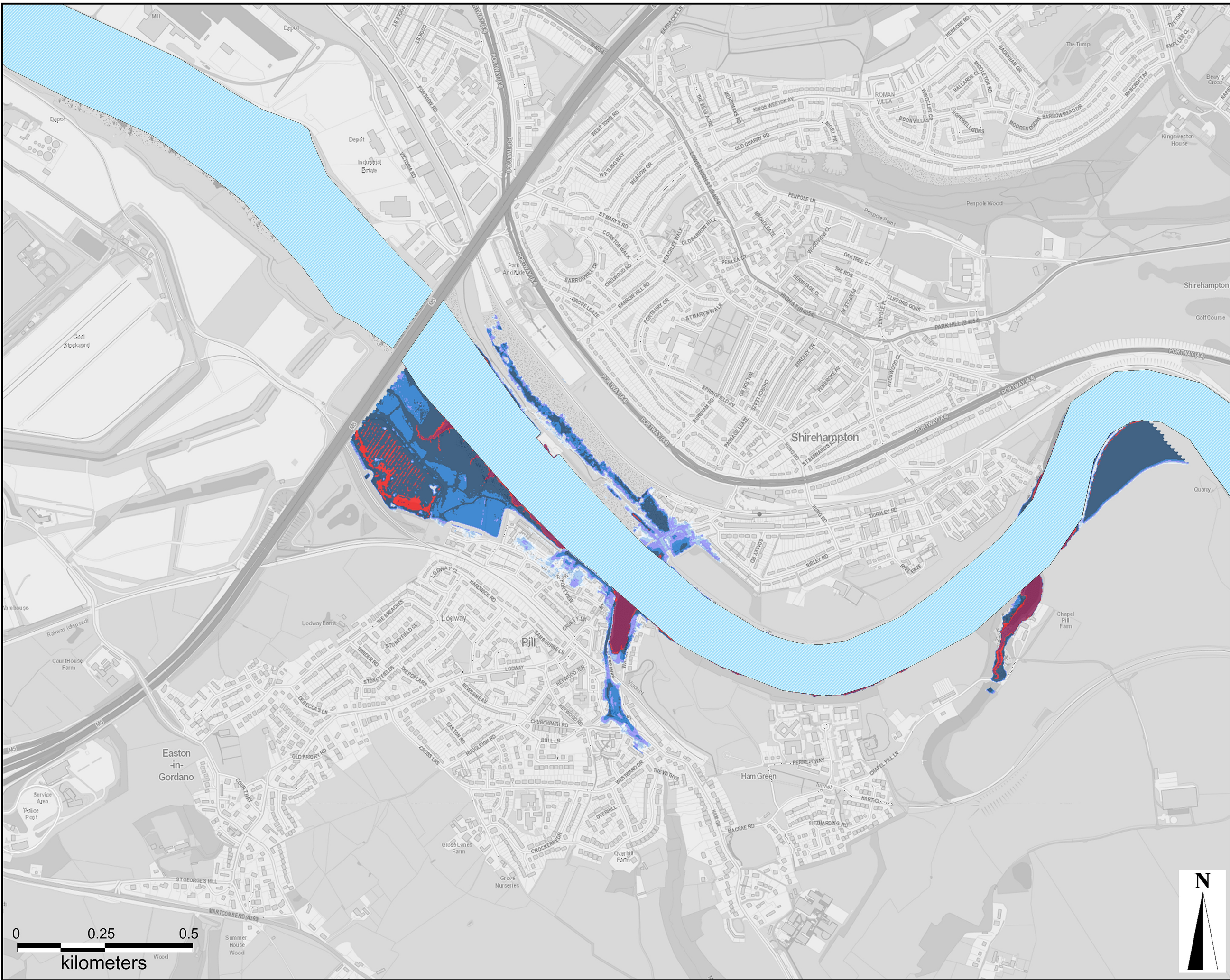
Scale at A3: 10,200

Drawing No: **Rev:**

FIGURE A-6 **1**

Drawn: Chk'd: App'd: **Date:**

RM MD JS June 2016



This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM, accept no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:



LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m

Model Reference:

CAFRA_134_20yr_FBAS0_T020_2030

Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

PILL & SHIREHAMPTON
RUN ID 7 - DO NOTHING
20 YR RETURN PERIOD
2030
MAXIMUM FLOOD DEPTH

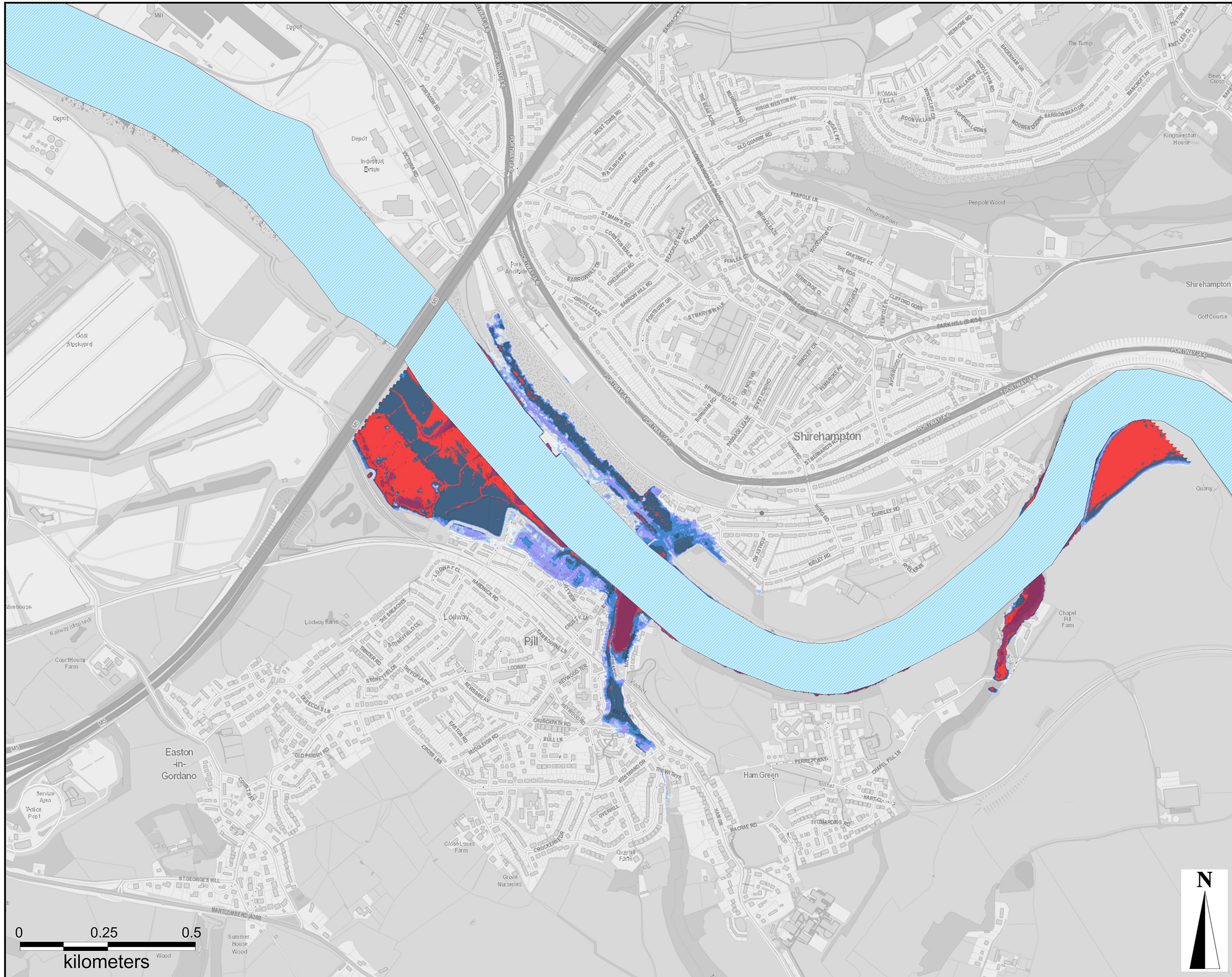
Scale at A3: 10,200

Drawing No: **Rev:**

FIGURE A-7 **1**

Drawn: Chk'd: App'd: **Date:**

RM MD JS June 2016



This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM, accept no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:



LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m

Model Reference:

CAFRA_135_100yr_FBASE_T100_2115

Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

PILL & SHIREHAMPTON
RUN ID 8 - DO NOTHING
75 YR RETURN PERIOD
2030
MAXIMUM FLOOD DEPTH

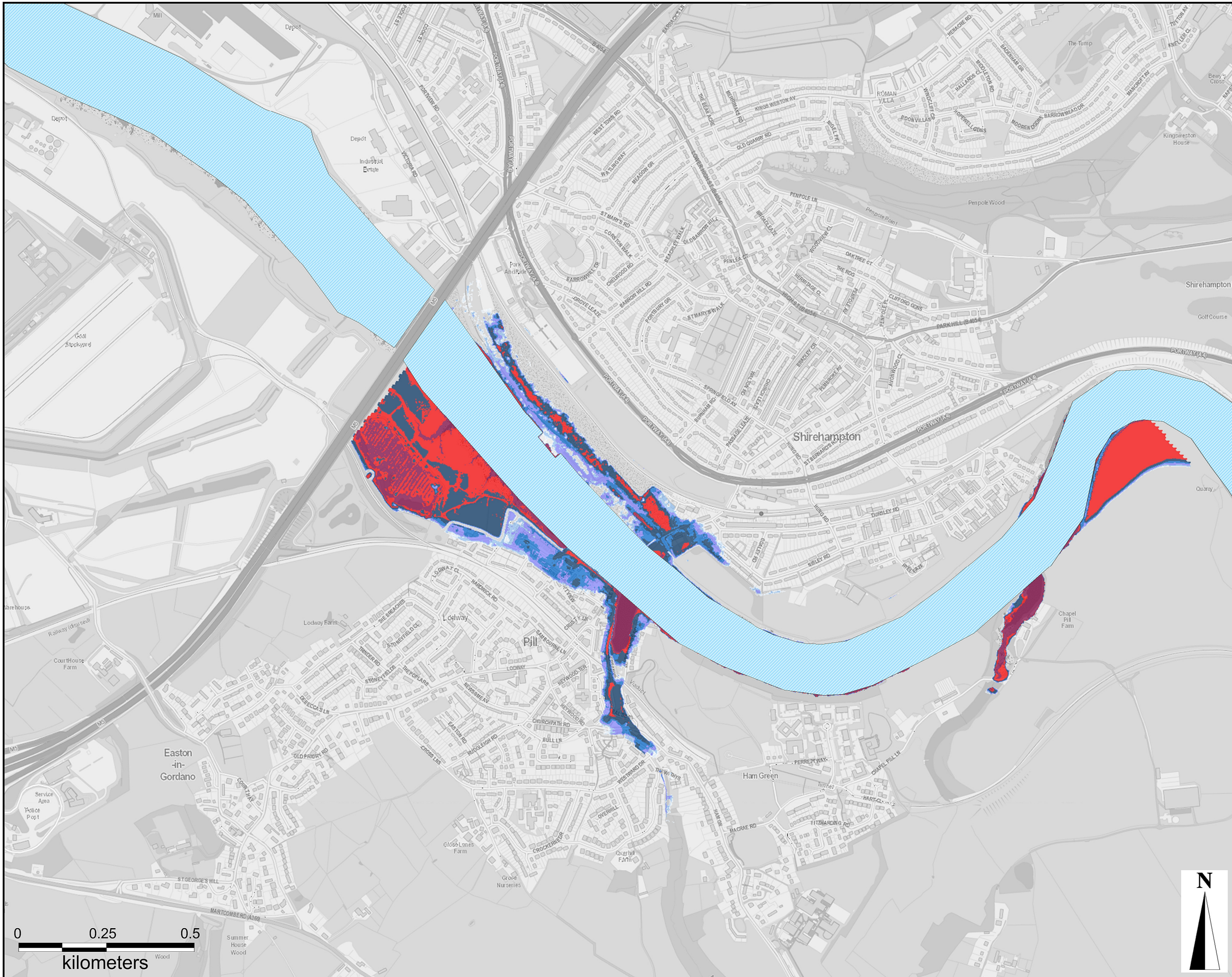
Scale at A3: 10,200

Drawing No: **Rev:**

FIGURE A-8 **1**

Drawn: Chk'd: App'd: **Date:**

RM MD JS June 2016



This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM, accept no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:



LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m

Model Reference:

CAFRA_134_200yr_F002_T200_2030

Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

PILL & SHIREHAMPTON
RUN ID 9 - DO NOTHING
200 YR RETURN PERIOD
2030
MAXIMUM FLOOD DEPTH

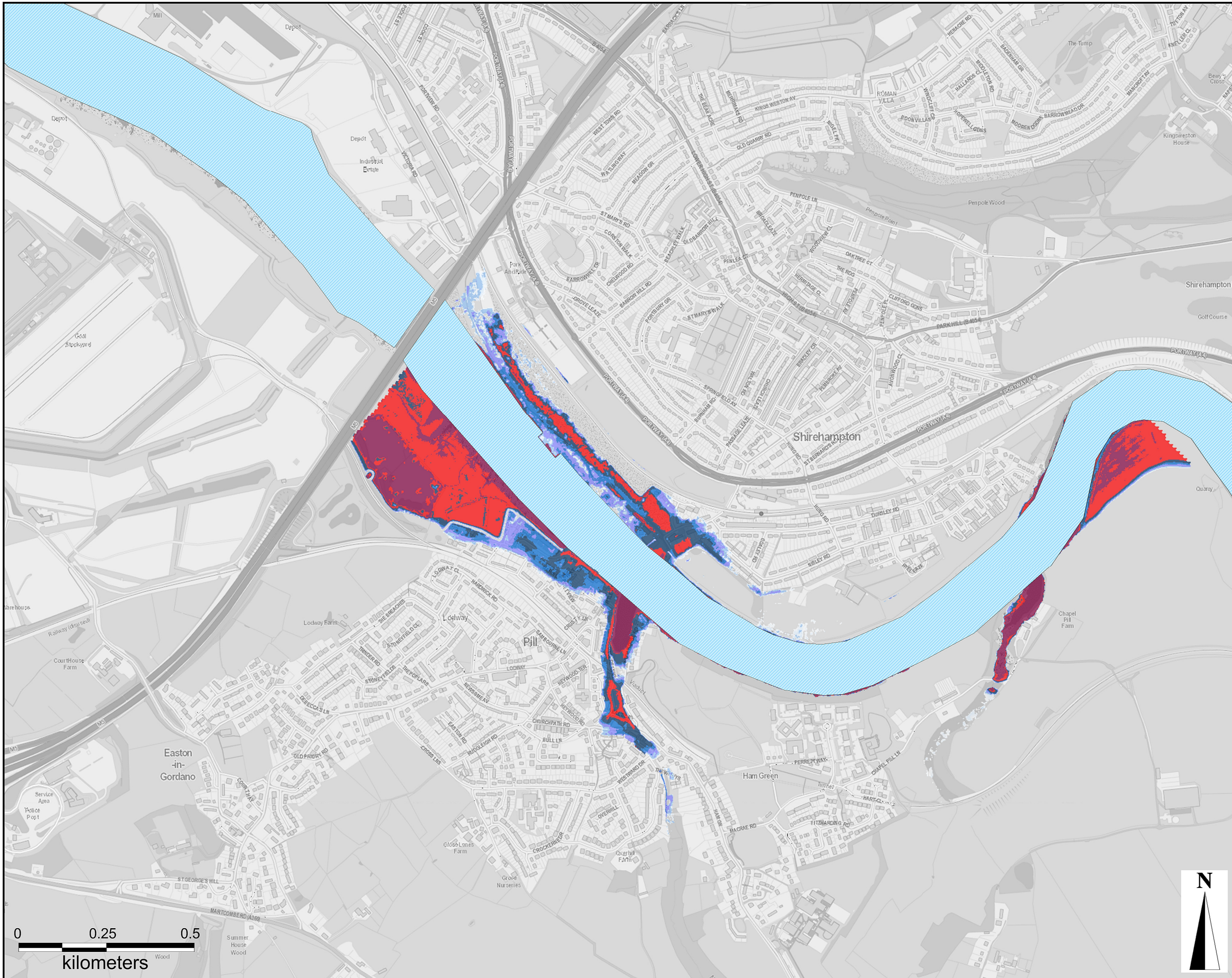
Scale at A3: 10,200

Drawing No: **Rev:**

FIGURE A-9 1

Drawn: Chk'd: App'd: **Date:**

RM MD JS June 2016



This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM, except as required by law. AECOM accepts no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:



LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m

Model Reference:

CAFRA_134_1000yr_F012_T1000_2030

Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

PILL & SHIREHAMPTON
RUN ID 10 - DO NOTHING
1000 YR RETURN PERIOD
2030
MAXIMUM FLOOD DEPTH

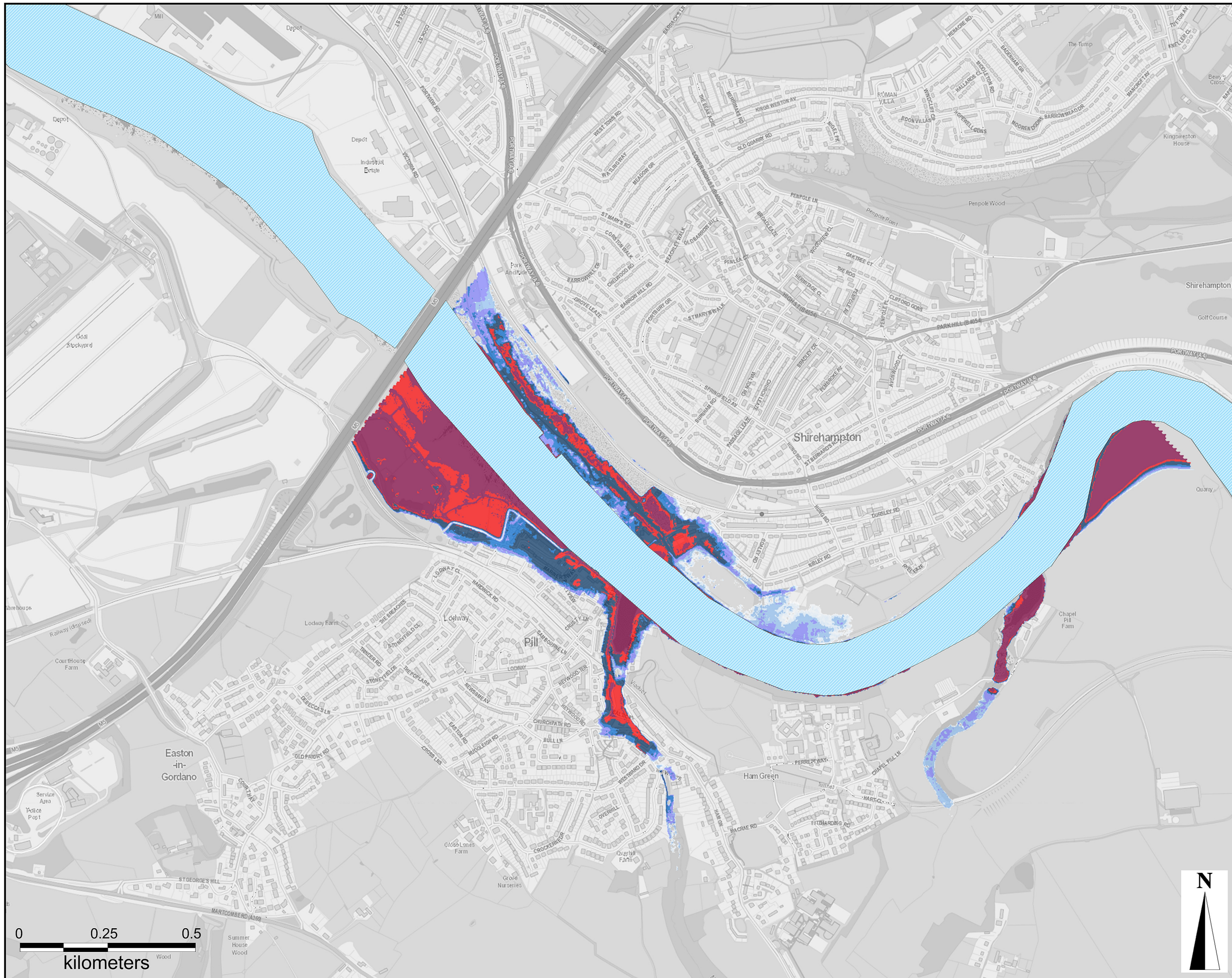
Scale at A3: 10,200

Drawing No: **Rev:**

FIGURE A-10 1

Drawn: Chk'd: App'd: **Date:**

RM MD JS June 2016



This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM. AECOM accepts no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:



LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m

Model Reference:

CAFRA_135_2yr_FBASE_T002_2065

Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

PILL & SHIREHAMPTON
RUN ID 11 - DO NOTHING
2 YR RETURN PERIOD
2065
MAXIMUM FLOOD DEPTH

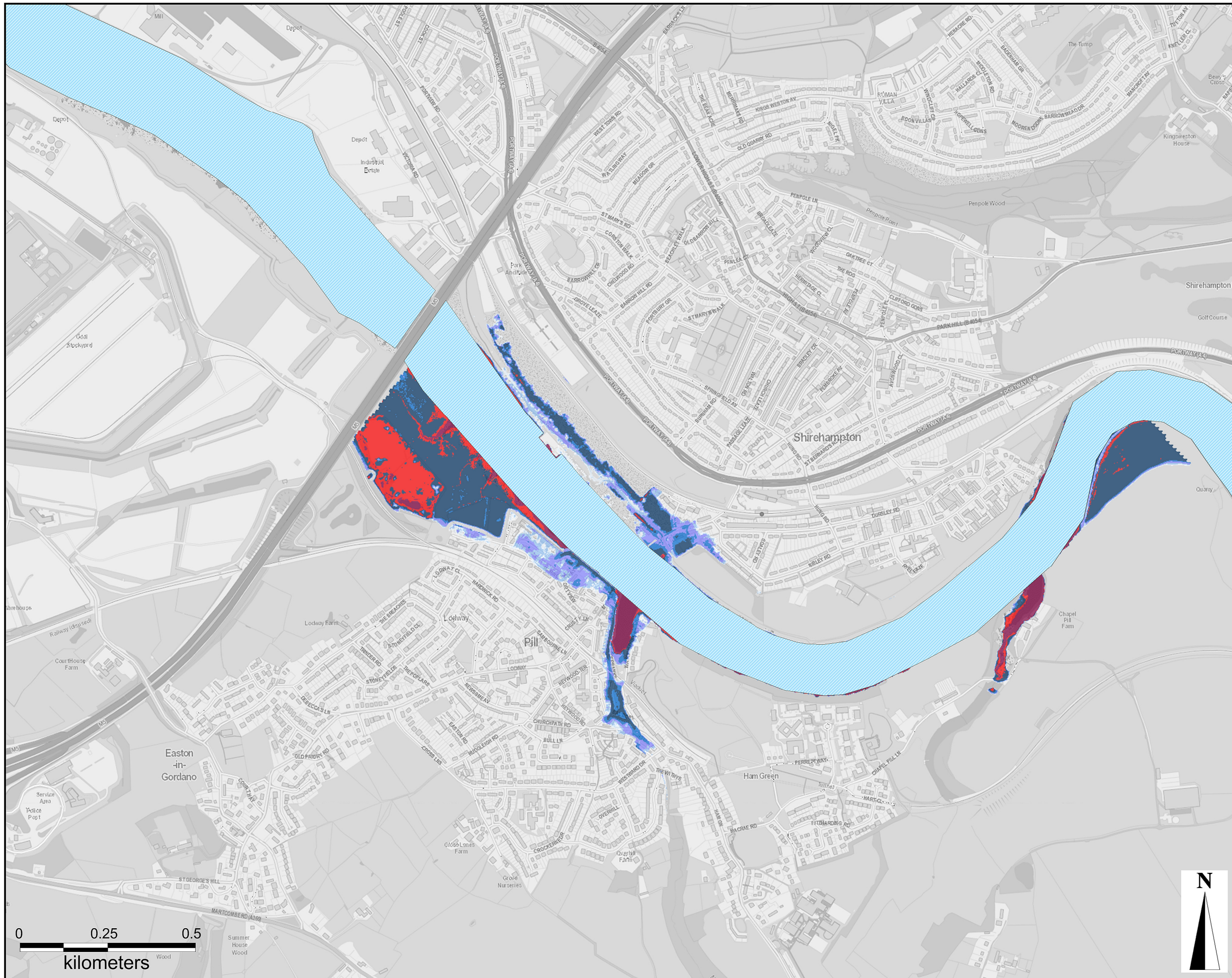
Scale at A3: 10,200

Drawing No: **Rev:**

FIGURE A-11 **1**

Drawn: Chk'd: App'd: **Date:**

RM MD JS June 2016



This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:



LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m

Model Reference:

CAFRA_135_100yr_FBASE_T100_2115

Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

PILL & SHIREHAMPTON
RUN ID 12 - DO NOTHING
20 YR RETURN PERIOD
2065
MAXIMUM FLOOD DEPTH

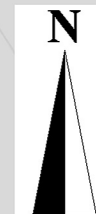
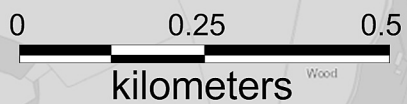
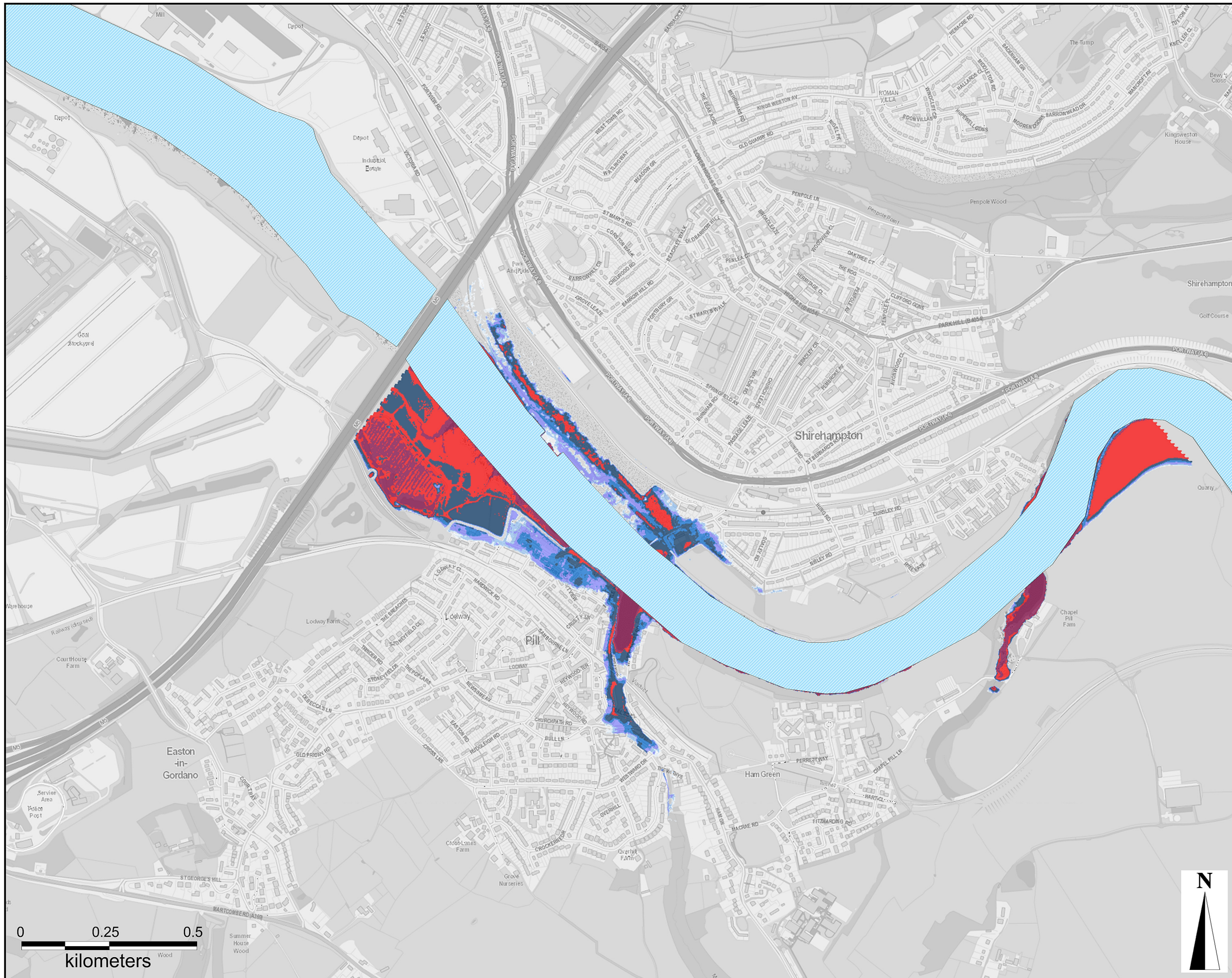
Scale at A3: 10,200

Drawing No:

FIGURE A-12

Drawn: Chk'd: App'd: Date:

RM MD JS June 2016



This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM in writing. AECOM accepts no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the related dimensions.

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:



LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m

Model Reference:

CAFRA_135_75yr_FBASE_T075_2065

Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

PILL & SHIREHAMPTON
RUN ID 13 - DO NOTHING
75 YR RETURN PERIOD
2065
MAXIMUM FLOOD DEPTH

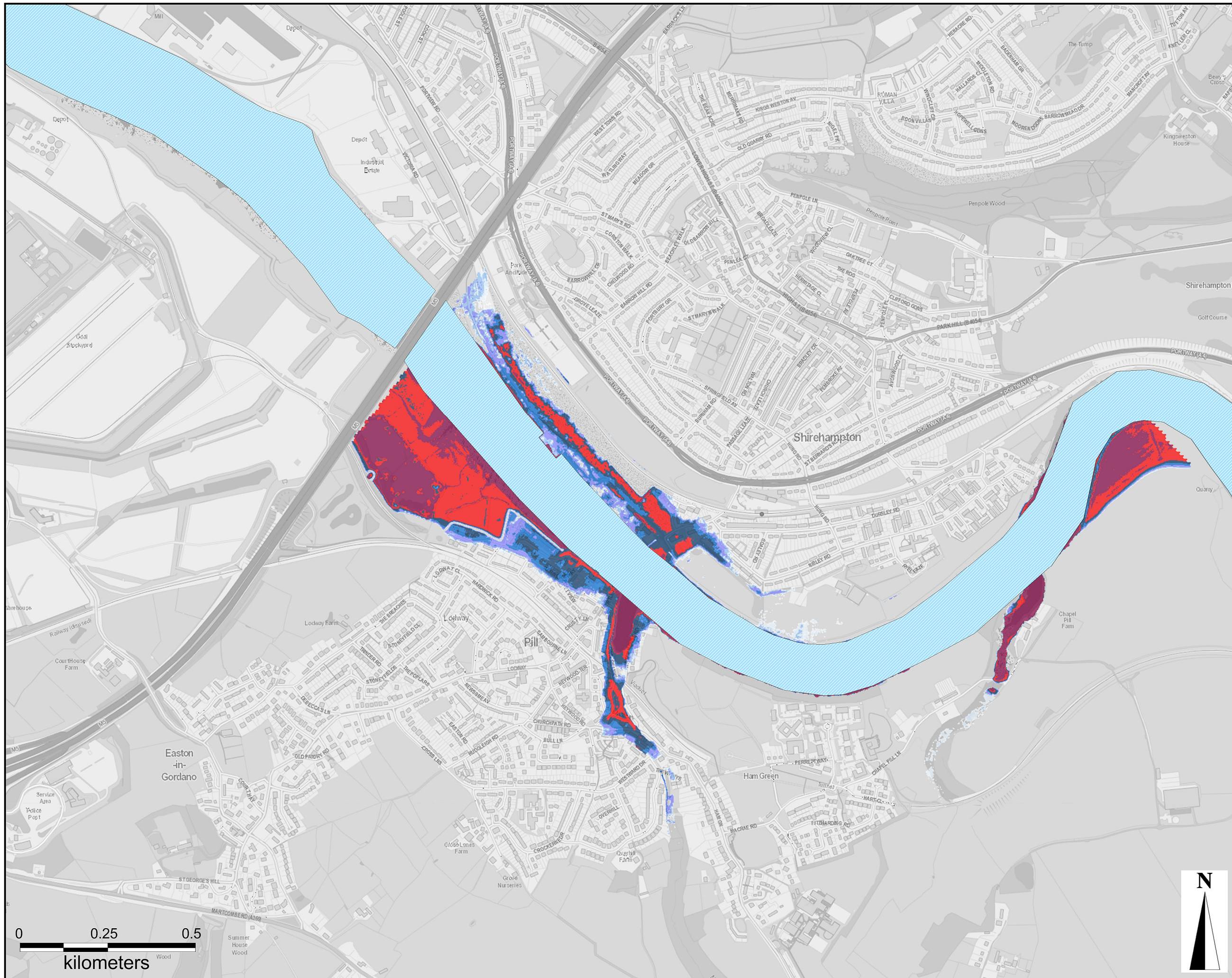
Scale at A3: 10,200

Drawing No: **Rev:**

FIGURE A-13 **1**

Drawn: Chk'd: App'd: **Date:**

RM MD JS June 2016



This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM, except as required by law. AECOM accepts no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:



LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m

Model Reference:

CAFRA_135_200yr_F002_T200_2065

Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

PILL & SHIREHAMPTON
RUN ID 14 - DO NOTHING
200 YR RETURN PERIOD
2065
MAXIMUM FLOOD DEPTH

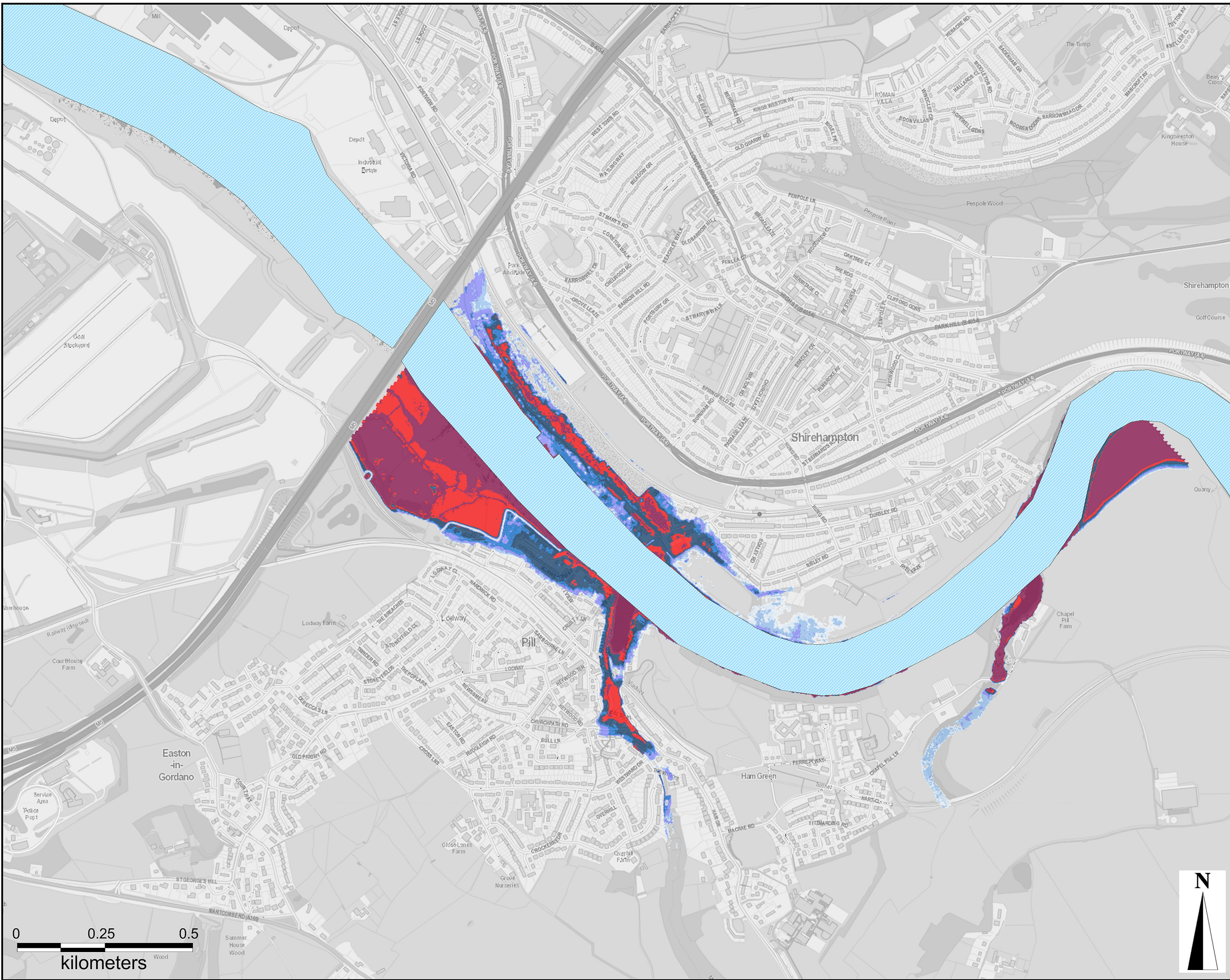
Scale at A3: 10,200

Drawing No: **Rev:**

FIGURE A-14 **1**

Drawn: Chk'd: App'd: **Date:**

RM MD JS June 2016



This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM, except as required by law. AECOM accepts no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:



LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m

Model Reference:

CAFRA_135_1000yr_F012_T1000_2065

Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

PILL & SHIREHAMPTON
RUN ID 15 - DO NOTHING
1000 YR RETURN PERIOD
2065
MAXIMUM FLOOD DEPTH

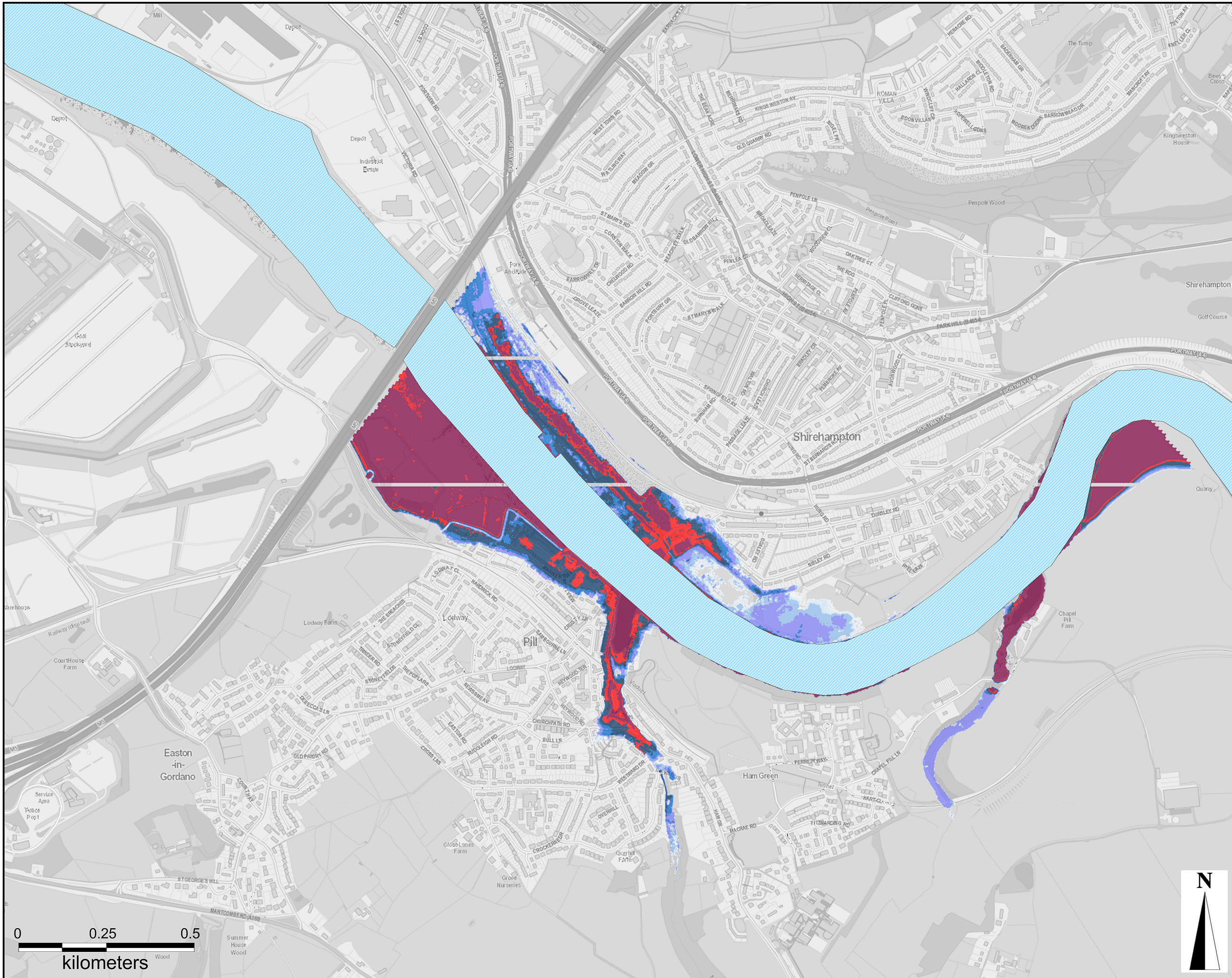
Scale at A3: 10,200

Drawing No: **Rev:**

FIGURE A-15

Drawn: Chk'd: App'd: **Date:**

RM MD JS June 2016



This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM. AECOM accepts no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:



LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m

Model Reference:

CAFRA_135_2yr_FBASE_T002_2115

Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

PILL & SHIREHAMPTON
RUN ID 16 - DO NOTHING
2 YR RETURN PERIOD
2115
MAXIMUM FLOOD DEPTH

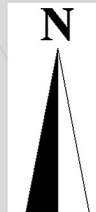
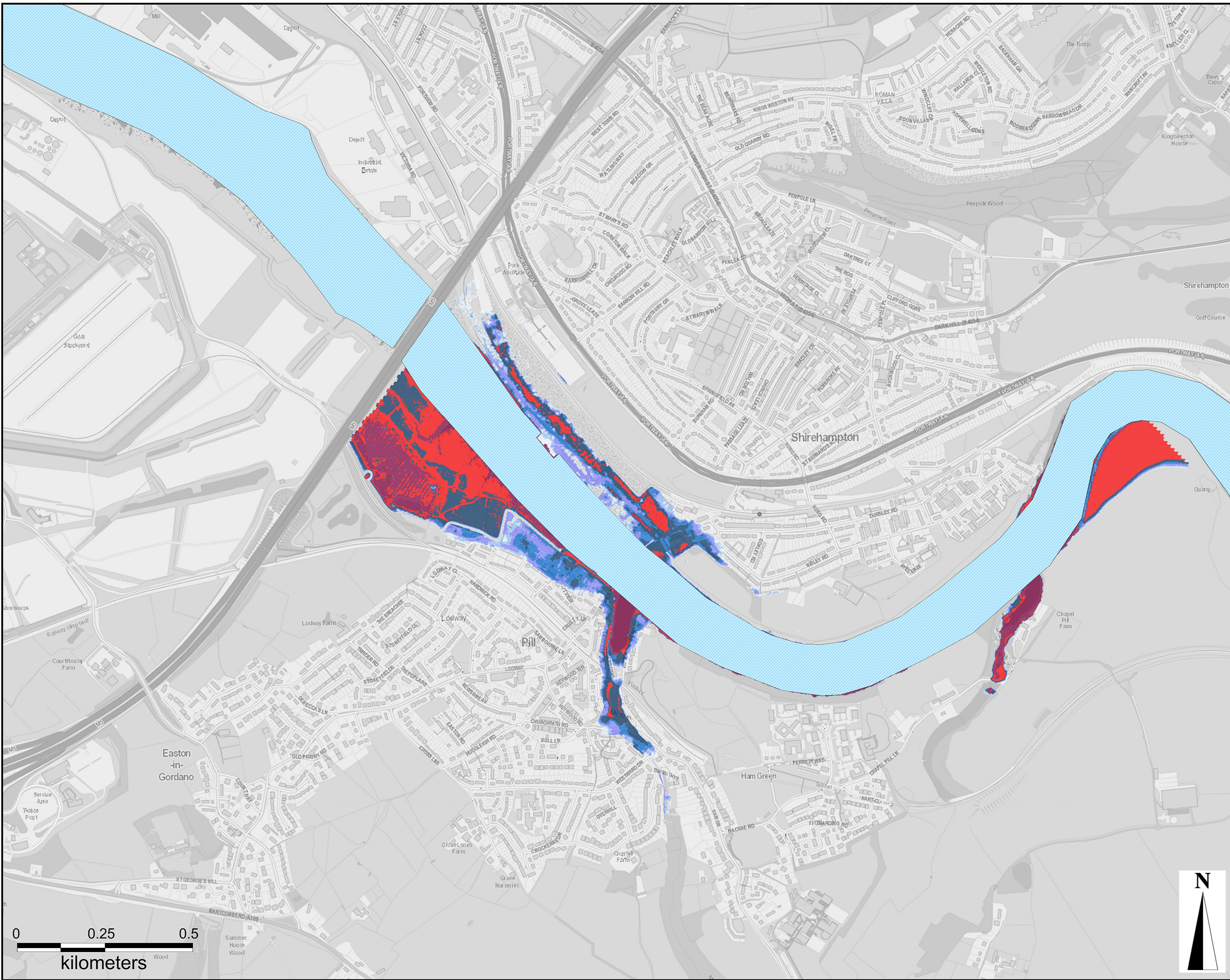
Scale at A3: 10,200

Drawing No: **Rev:**

FIGURE A-16

Drawn: Chk'd: App'd: **Date:**

RM MD JS June 2016



This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM, accept no responsibility, and disavow any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:



LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m

Model Reference:

CAFRA_135_20yr_FBAS0_T020_2115

Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

PILL & SHIREHAMPTON
RUN ID 17 - DO NOTHING
20 YR RETURN PERIOD
2115
MAXIMUM FLOOD DEPTH

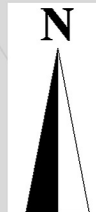
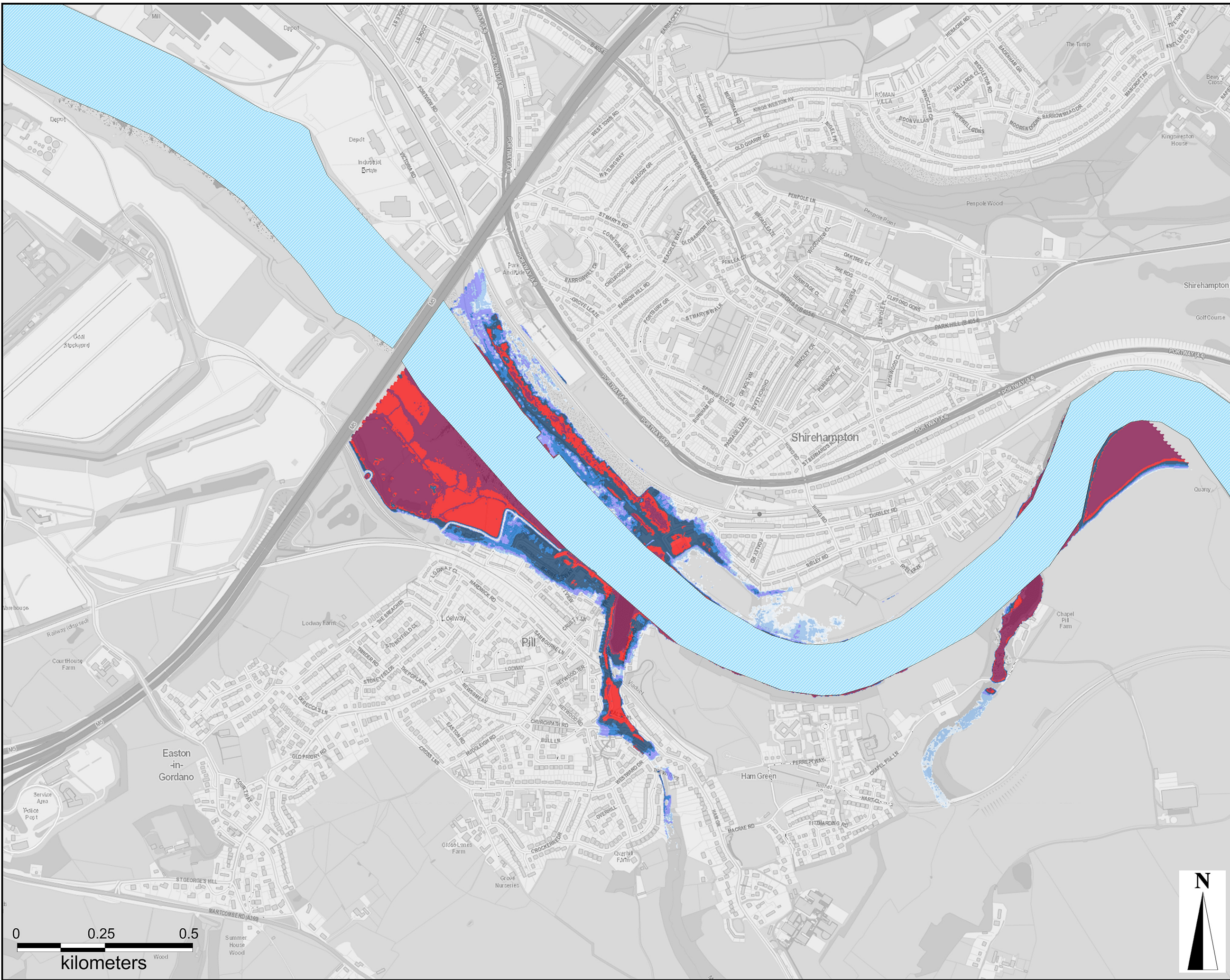
Scale at A3: 10,200

Drawing No: **Rev:**

FIGURE A-17

Drawn: Chk'd: App'd: **Date:**

RM MD JS June 2016



This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM in writing. AECOM accepts no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:



LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m

Model Reference:

CAFRA_135_75yr_FBASE_T075_2115

Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

PILL & SHIREHAMPTON
RUN ID 18 - DO NOTHING
75 YR RETURN PERIOD
2115
MAXIMUM FLOOD DEPTH

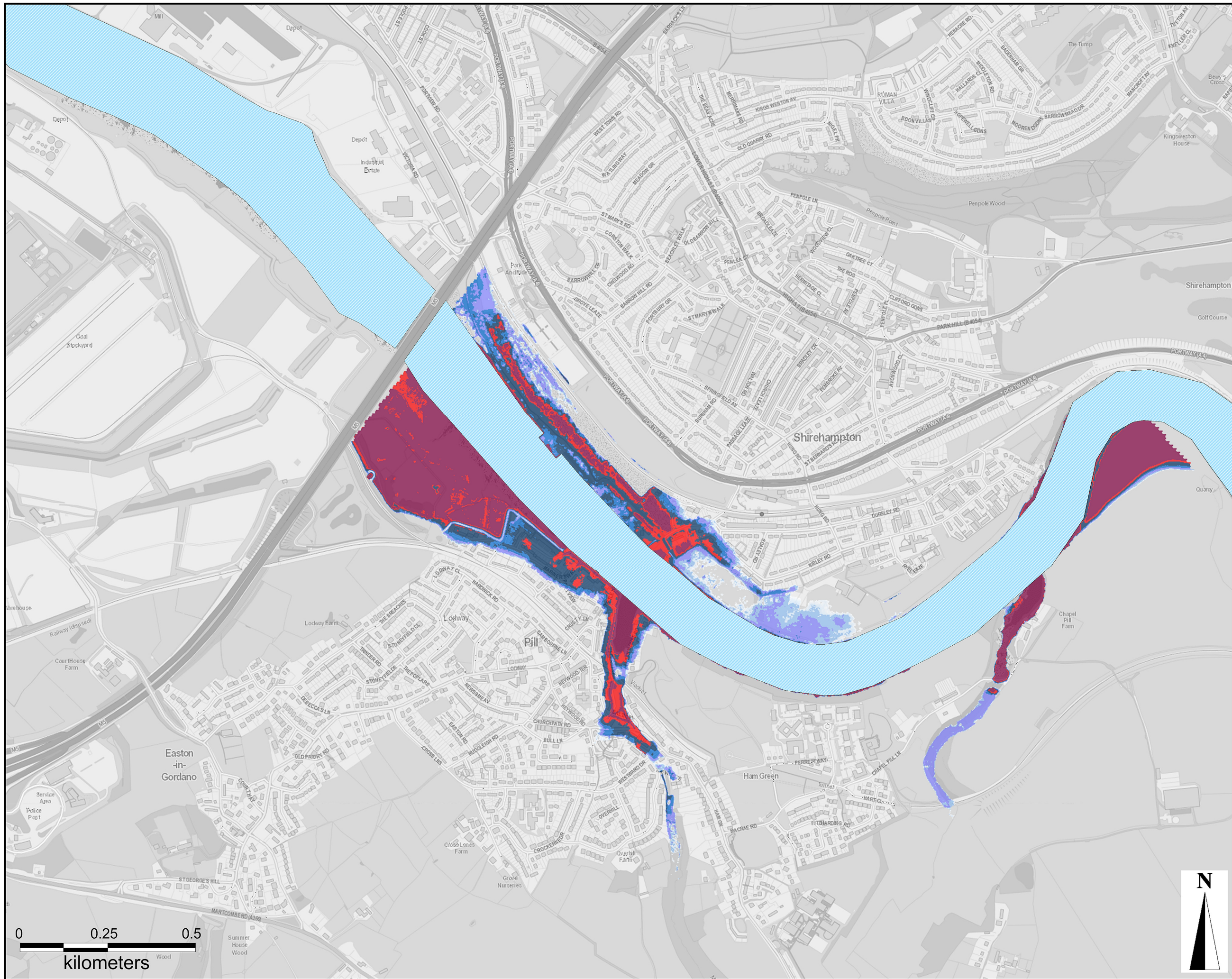
Scale at A3: 10,200

Drawing No: **Rev:**

FIGURE A-18

Drawn: Chk'd: App'd: **Date:**

RM MD JS June 2016



This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM. AECOM accepts no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:



LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m

Model Reference:

CAFRA_135_200yr_F002_T200_2115

Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

PILL & SHIREHAMPTON
RUN ID 19 - DO NOTHING
200 YR RETURN PERIOD
2115
MAXIMUM FLOOD DEPTH

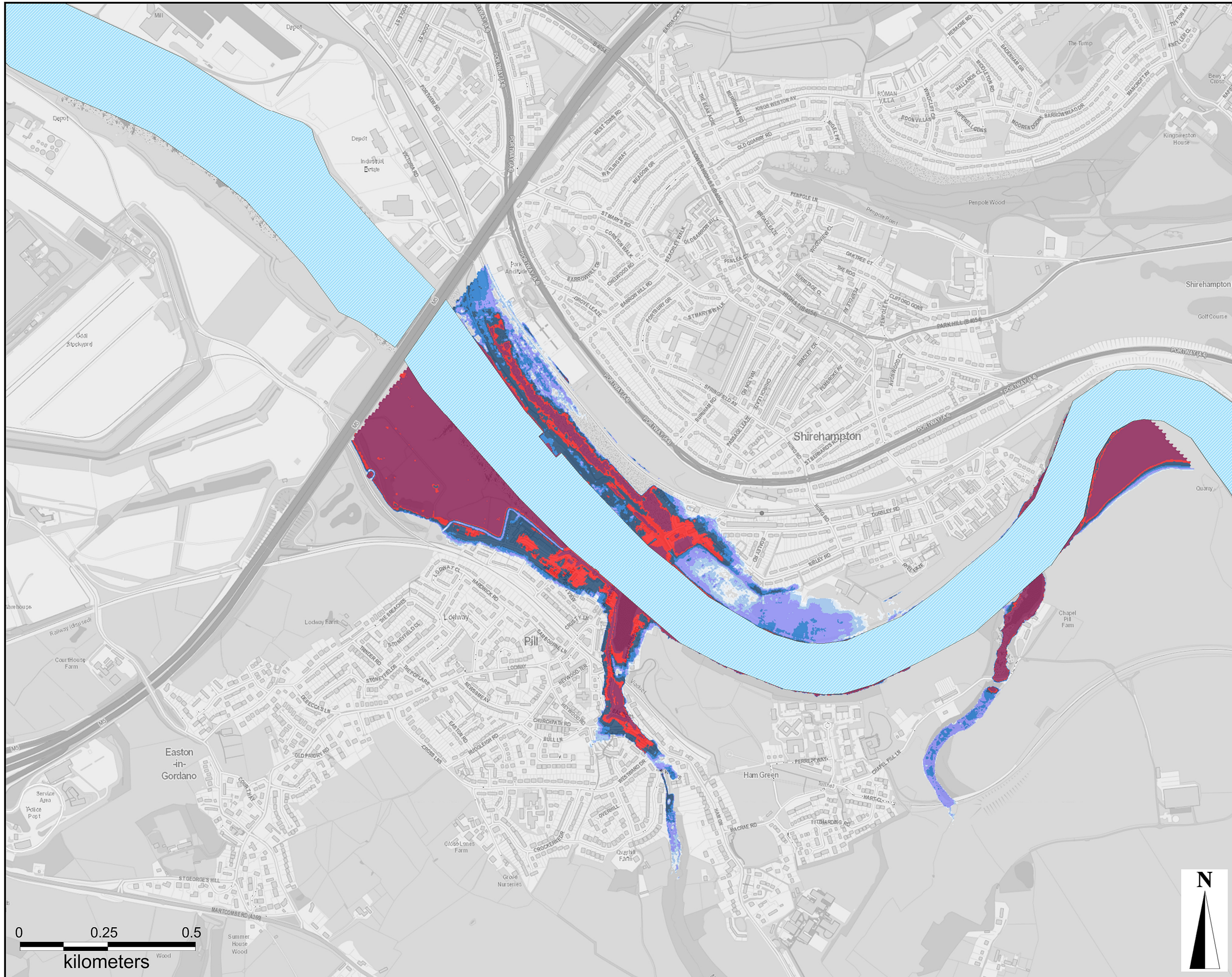
Scale at A3: 10,200

Drawing No: **Rev:**

FIGURE A-19 **1**

Drawn: Chk'd: App'd: **Date:**

RM MD JS June 2016



This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM. AECOM accepts no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:



LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m

Model Reference:

CAFRA_135_1000yr_F012_T1000_2115

Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

PILL & SHIREHAMPTON
RUN ID 20 - DO NOTHING
1000 YR RETURN PERIOD
2115
MAXIMUM FLOOD DEPTH

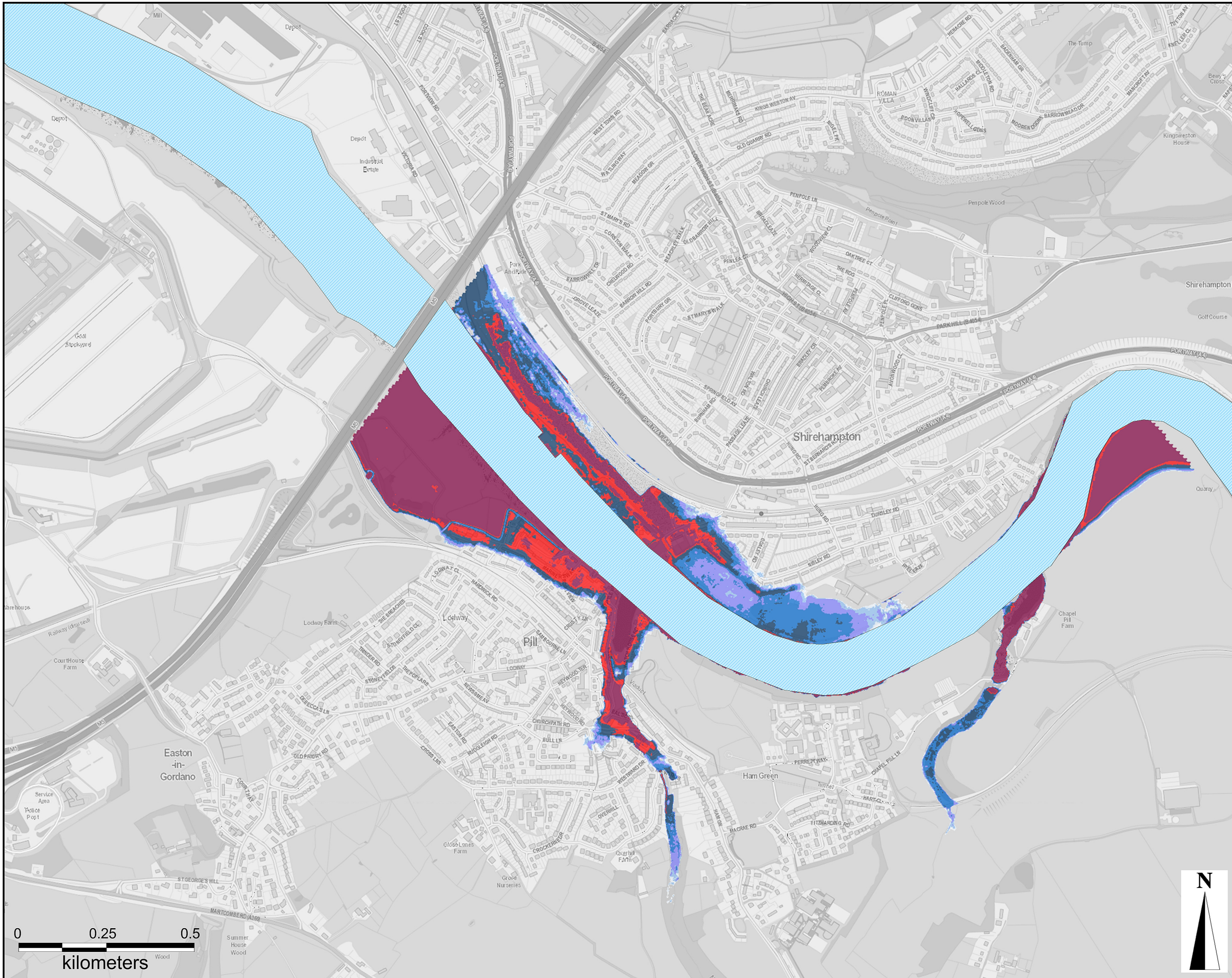
Scale at A3: 10,200

Drawing No: **Rev:**

FIGURE A-20 1

Drawn: Chk'd: App'd: **Date:**

RM MD JS June 2016



This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM. AECOM accepts no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

5.2 Appendix B: Pill / Shirehampton Do Minimum Flood Maps

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:



LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m

Model Reference:

CAFRA_132_2yr_FBASE_T002_2015

Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

PILL & SHIREHAMPTON
RUN ID 21 - DO MINIMUM
2 YR RETURN PERIOD
2015
MAXIMUM FLOOD DEPTH

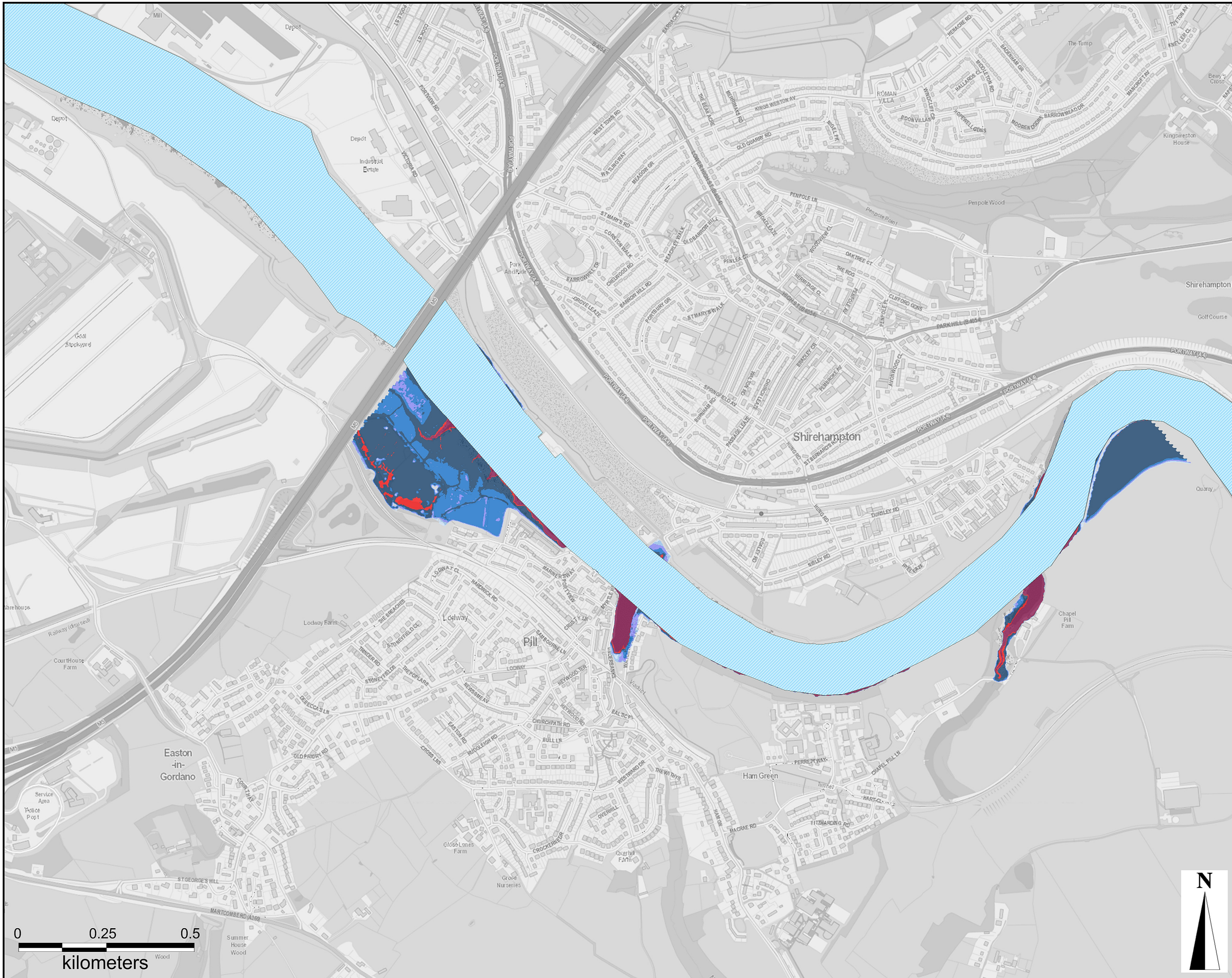
Scale at A3: 10,200

Drawing No: **Rev:**

FIGURE A-21 1

Drawn: Chk'd: App'd: **Date:**

RM MD JS June 2016



This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as signed by AECOM or as required by law. AECOM accepts no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:



LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m

Model Reference:

CAFRA_132_20yr_FBAS0_T020_2015

Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

PILL & SHIREHAMPTON
RUN ID 22 - DO MINIMUM
20 YR RETURN PERIOD
2015
MAXIMUM FLOOD DEPTH

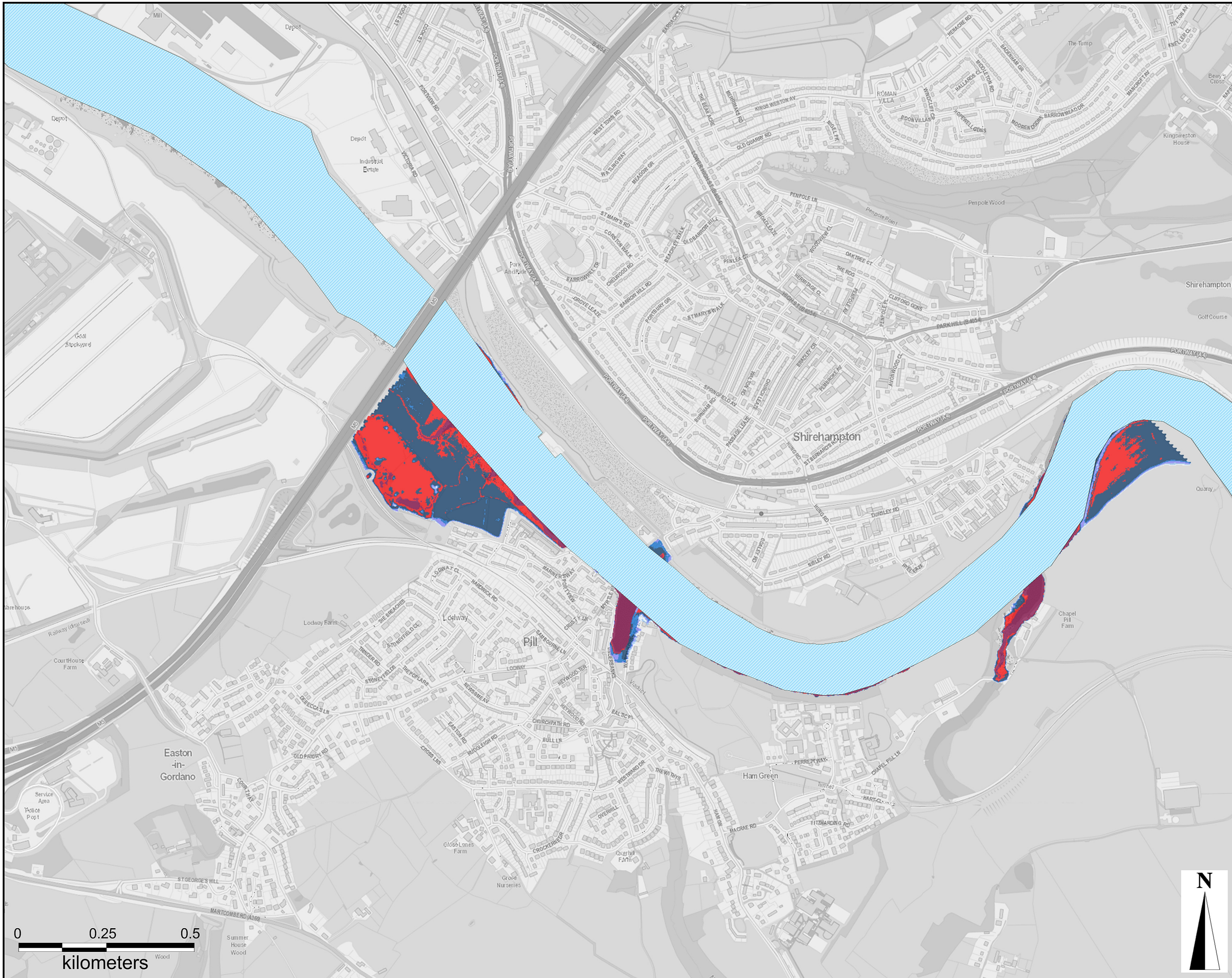
Scale at A3: 10,200

Drawing No: **Rev:**

FIGURE A-22 **1**

Drawn: Chk'd: App'd: **Date:**

RM MD JS June 2016



This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM in writing. AECOM accepts no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:



LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m

Model Reference:

CAFRA_132_75yr_FBASE_T075_2015

Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

PILL & SHIREHAMPTON
RUN ID 23 - DO MINIMUM
75 YR RETURN PERIOD
2015
MAXIMUM FLOOD DEPTH

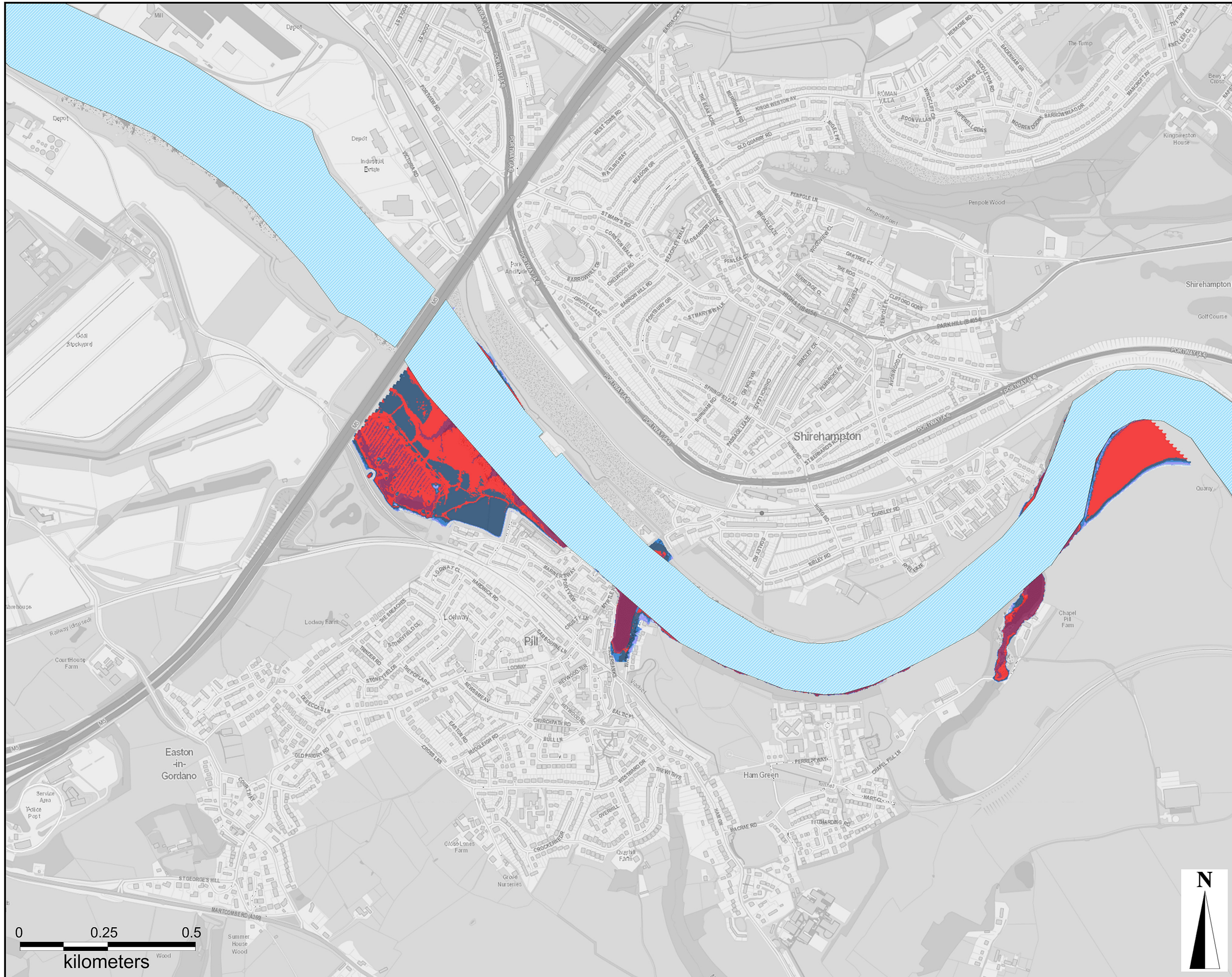
Scale at A3: 10,200

Drawing No: **Rev:**

FIGURE A-23 1

Drawn: Chk'd: App'd: **Date:**

RM MD JS June 2016



This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM, except as required by law. AECOM accepts no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:



LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m

Model Reference:

CAFRA_132_200yr_F002_T200_2015

Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

PILL & SHIREHAMPTON
RUN ID 24 - DO MINIMUM
200 YR RETURN PERIOD
2015
MAXIMUM FLOOD DEPTH

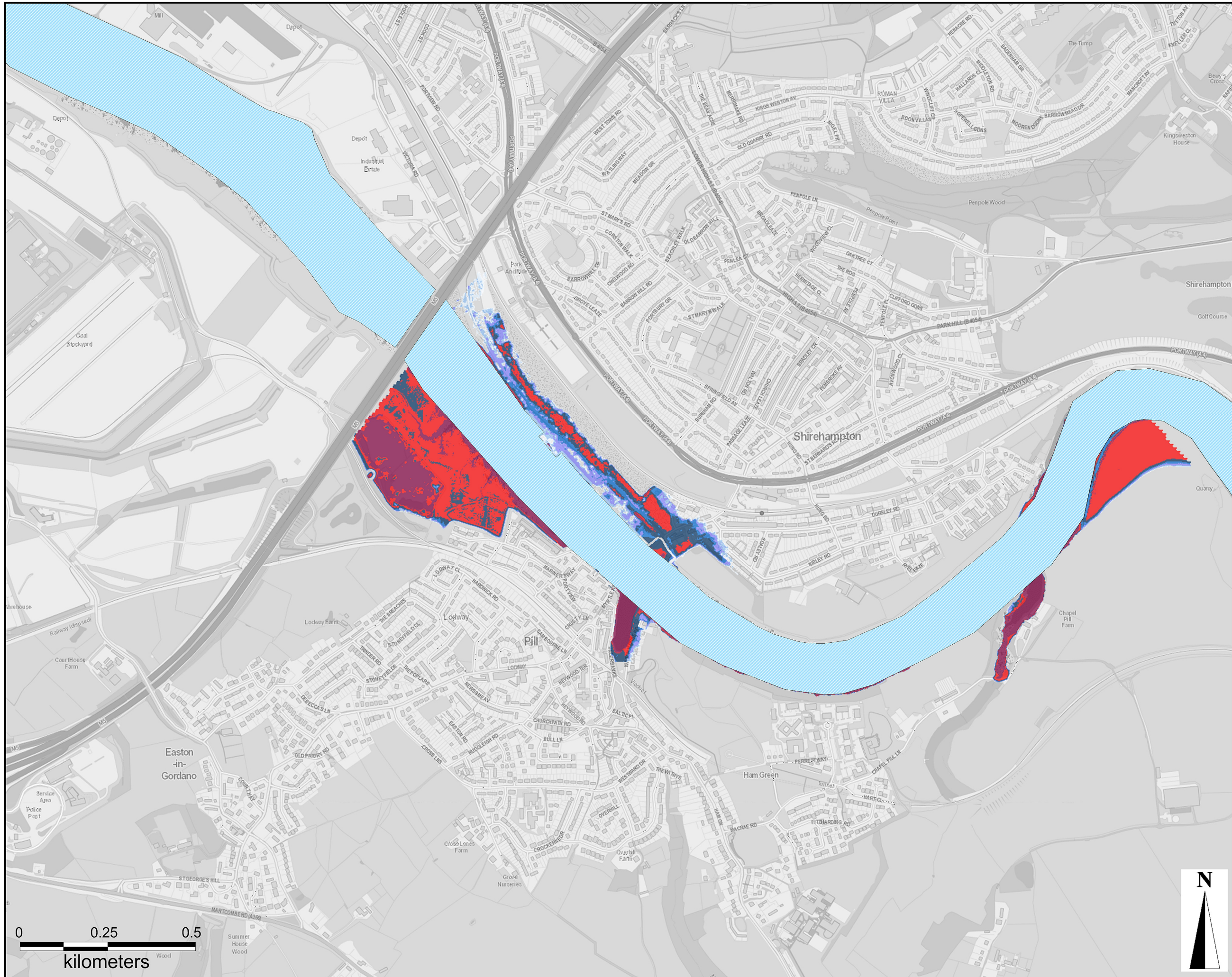
Scale at A3: 10,200

Drawing No: **Rev:**

FIGURE A-24 **1**

Drawn: Chk'd: App'd: **Date:**

RM MD JS June 2016



This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as signed by AECOM or as required by law. AECOM accepts no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:



LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m

Model Reference:

CAFRA_132_1000yr_F012_T1000_2015

Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

PILL & SHIREHAMPTON
RUN ID 25 - DO MINIMUM
1000 YR RETURN PERIOD
2015
MAXIMUM FLOOD DEPTH

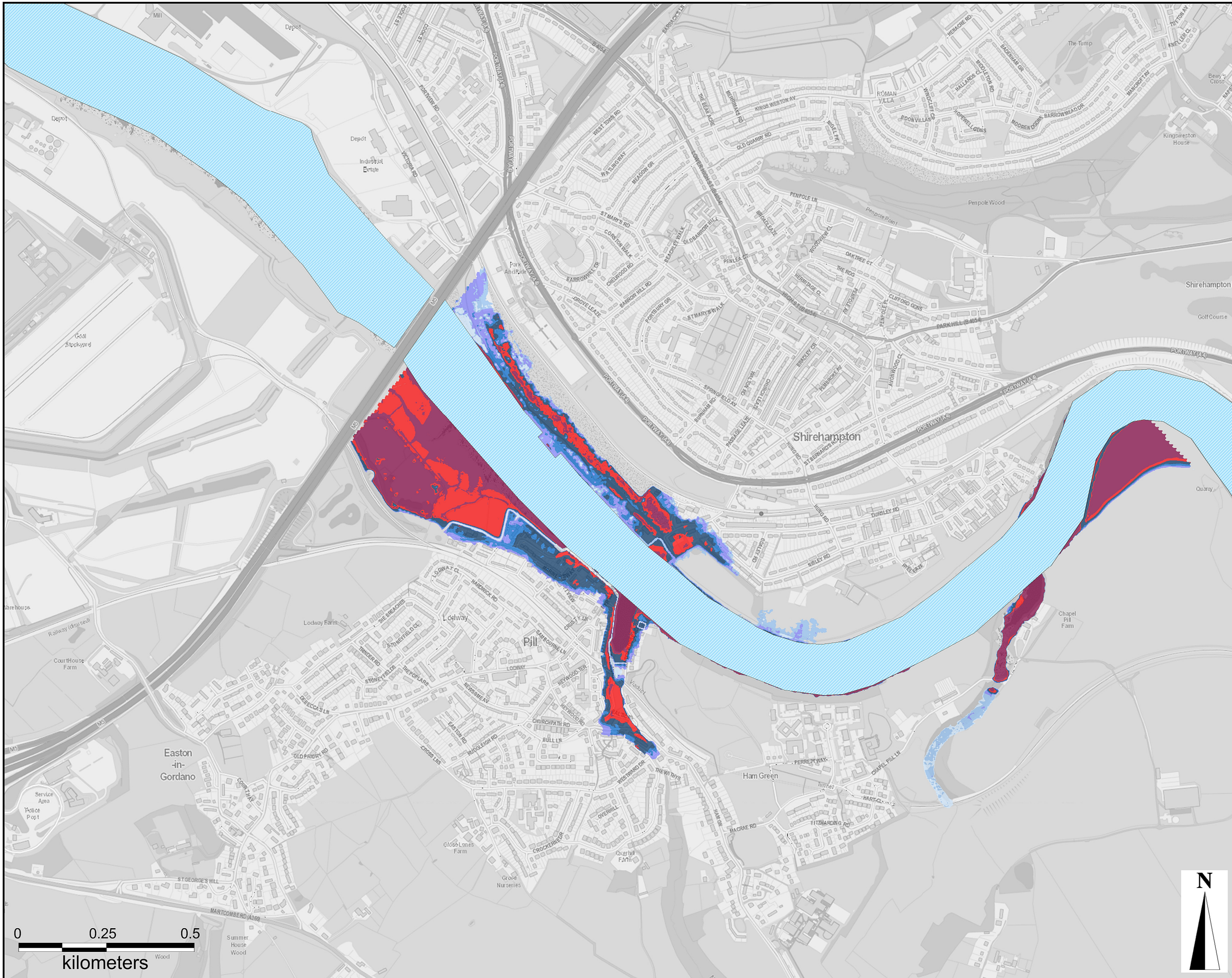
Scale at A3: 10,200

Drawing No: **Rev:**

FIGURE A-25 1

Drawn: Chk'd: App'd: **Date:**

RM MD JS June 2016



This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM. AECOM accepts no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:



LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m

Model Reference:

CAFRA_132_2yr_FBASE_T002_2030

Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

PILL & SHIREHAMPTON
RUN ID 26 - DO MINIMUM
2 YR RETURN PERIOD
2030
MAXIMUM FLOOD DEPTH

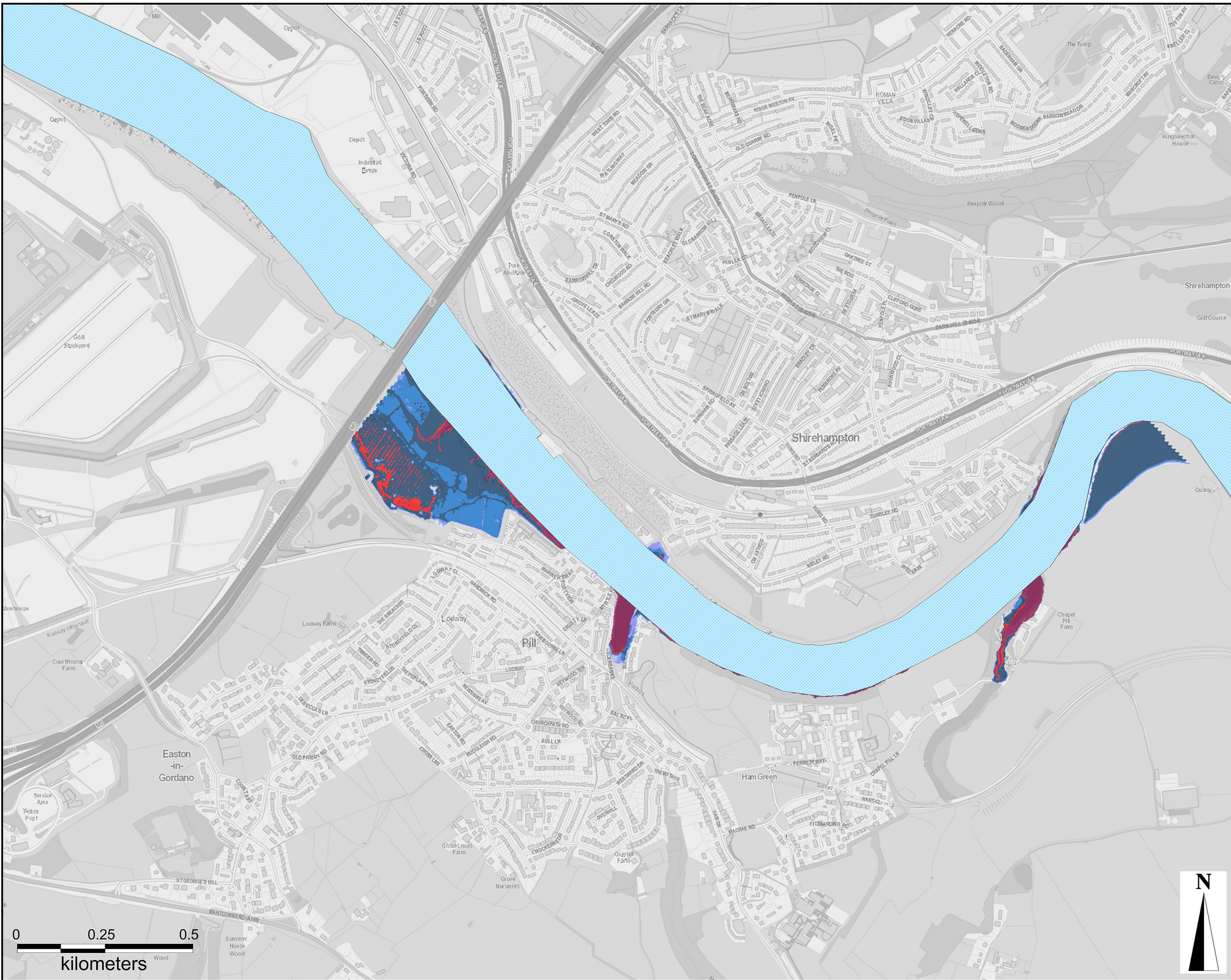
Scale at A3: 10,200

Drawing No: **Rev:**

FIGURE A-26 **1**

Drawn: Chk'd: App'd: **Date:**

RM MD JS June 2016



This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as signed by AECOM or as required by law. AECOM accepts no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:



LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m

Model Reference:

CAFRA_132_20yr_FBAS0_T020_2030

Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

PILL & SHIREHAMPTON
RUN ID 27 - DO MINIMUM
20 YR RETURN PERIOD
2030
MAXIMUM FLOOD DEPTH

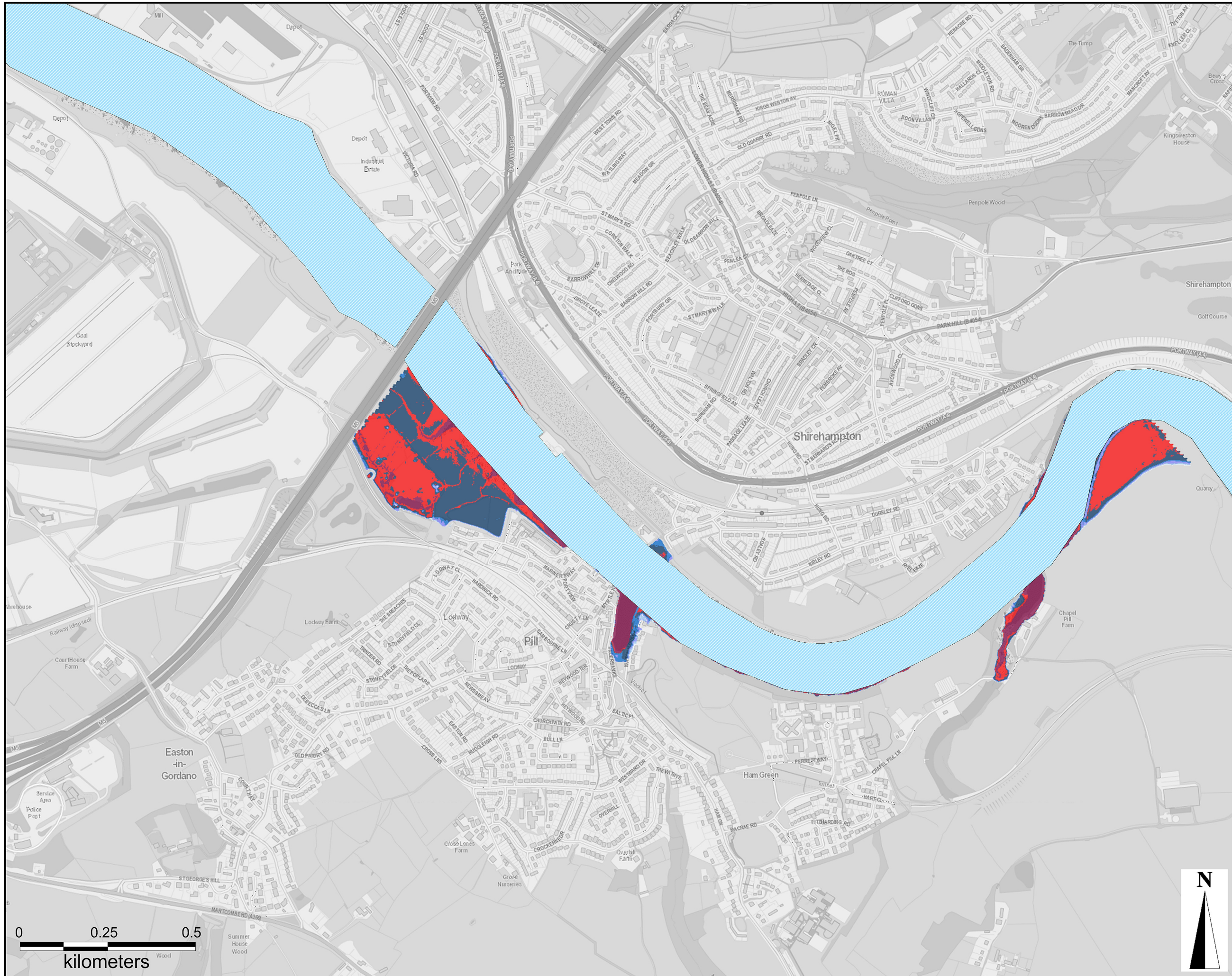
Scale at A3: 10,200

Drawing No: **Rev:**

FIGURE A-27 **1**

Drawn: Chk'd: App'd: **Date:**

RM MD JS June 2016



This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM, except as required by law. AECOM accepts no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:



LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m

Model Reference:

CAFRA_132_200yr_F002_T200_2030

Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

PILL & SHIREHAMPTON
RUN ID 29 - DO MINIMUM
200 YR RETURN PERIOD
2030
MAXIMUM FLOOD DEPTH

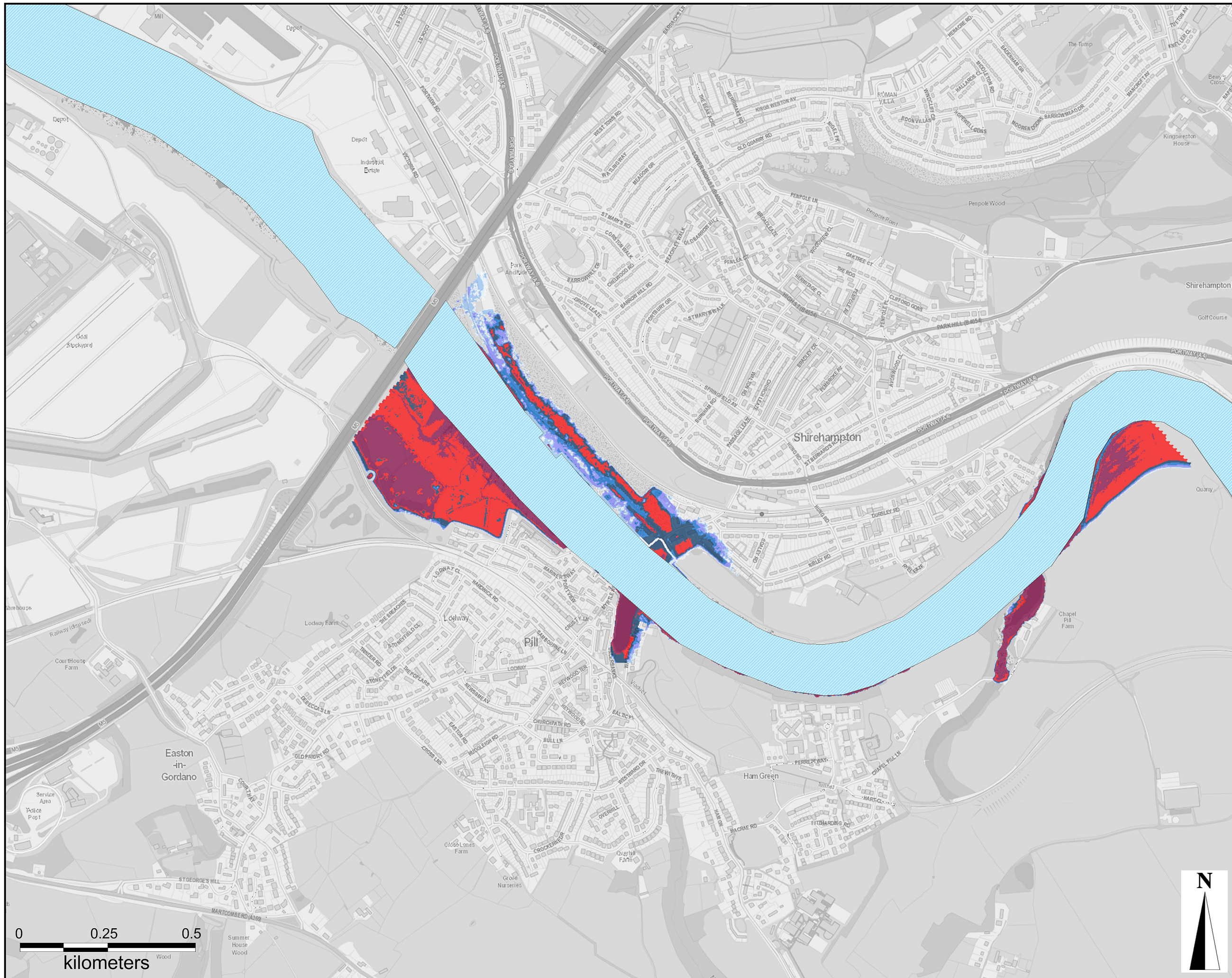
Scale at A3: 10,200

Drawing No: **Rev:**

FIGURE A-29 **1**

Drawn: Chk'd: App'd: **Date:**

RM MD JS June 2016



This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as signed by AECOM or as required by law. AECOM accepts no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:



LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m

Model Reference:

CAFRA_132_1000yr_F012_T1000_2030

Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

PILL & SHIREHAMPTON
RUN ID 30 - DO MINIMUM
1000 YR RETURN PERIOD
2030
MAXIMUM FLOOD DEPTH

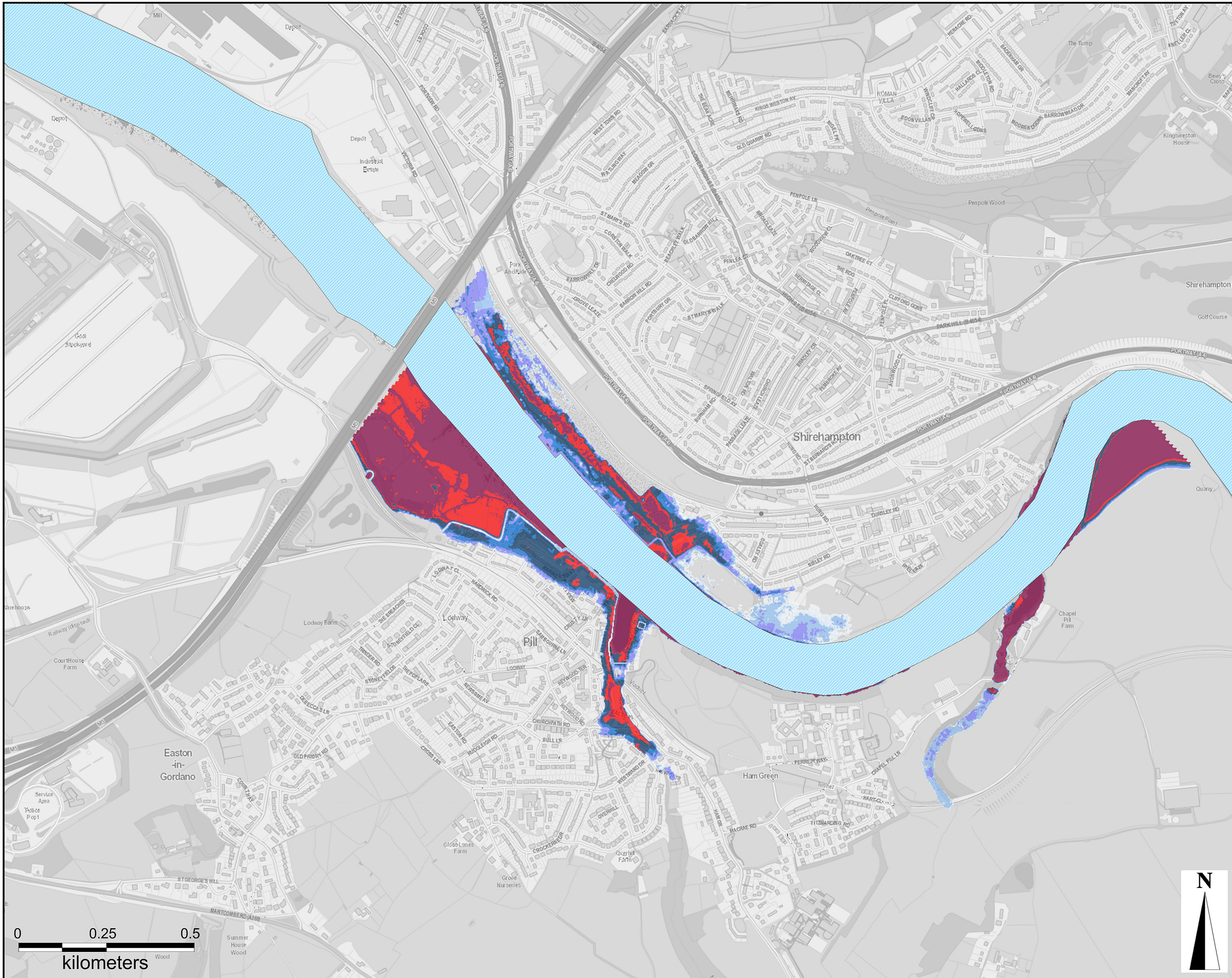
Scale at A3: 10,200

Drawing No: **Rev:**

FIGURE A-30 1

Drawn: Chk'd: App'd: **Date:**

RM MD JS June 2016



This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM. AECOM accepts no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:

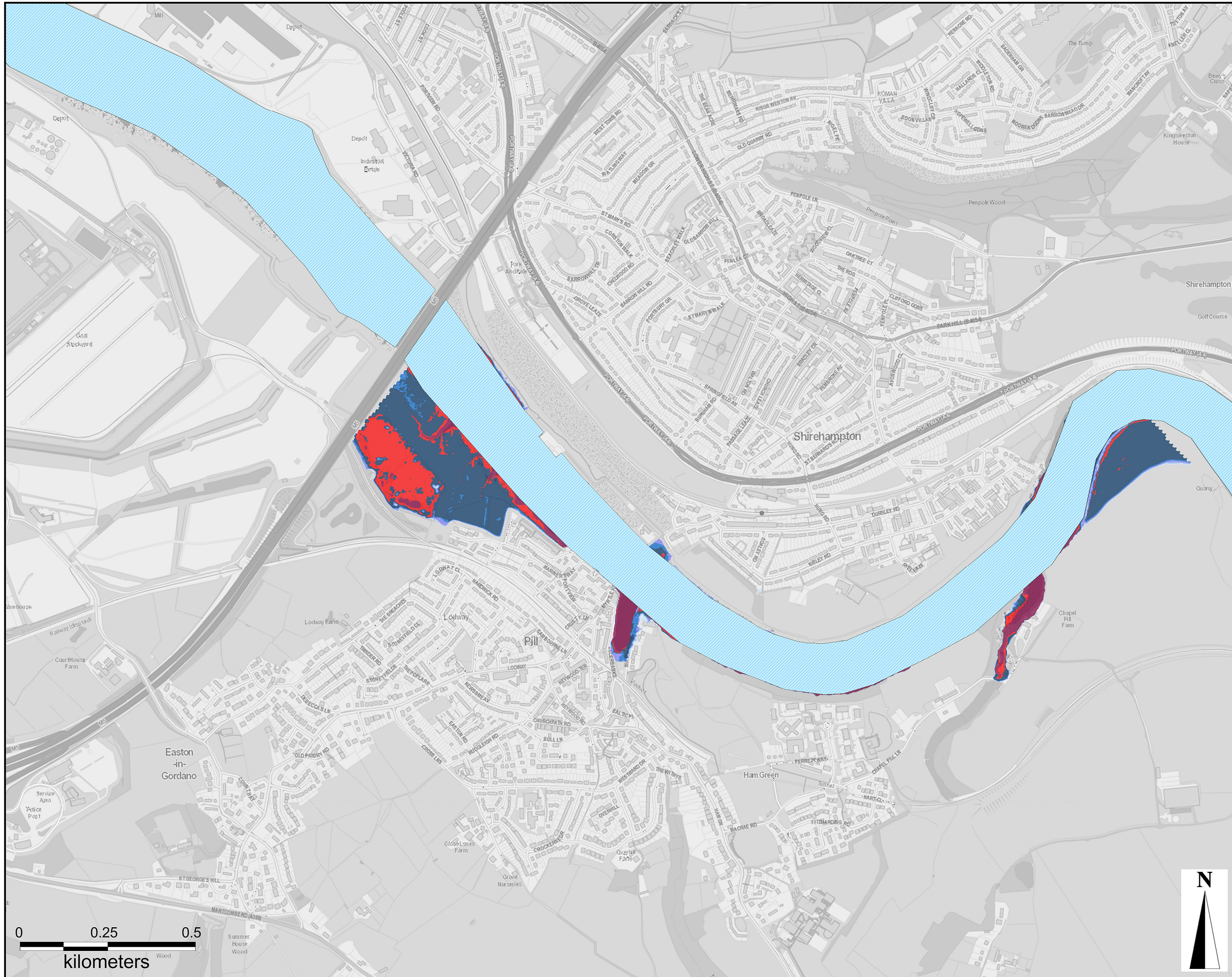


LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m



Model Reference:

CAFRA_132_2yr_FBASE_T002_2065

Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

PILL & SHIREHAMPTON
RUN ID 31 - DO MINIMUM
2 YR RETURN PERIOD
2065
MAXIMUM FLOOD DEPTH

Scale at A3: 10,200

Drawing No: **Rev:**

FIGURE A-31 **1**

Drawn: Chk'd: App'd: **Date:**

RM MD JS June 2016

This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM, except as required by law. AECOM accepts no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:



LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m

Model Reference:

CAFRA_132_75yr_FBAS0_T075_2065

Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

PILL & SHIREHAMPTON
RUN ID 33 - DO MINIMUM
75 YR RETURN PERIOD
2065
MAXIMUM FLOOD DEPTH

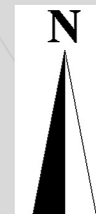
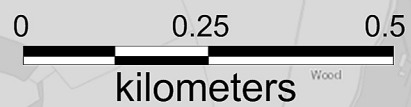
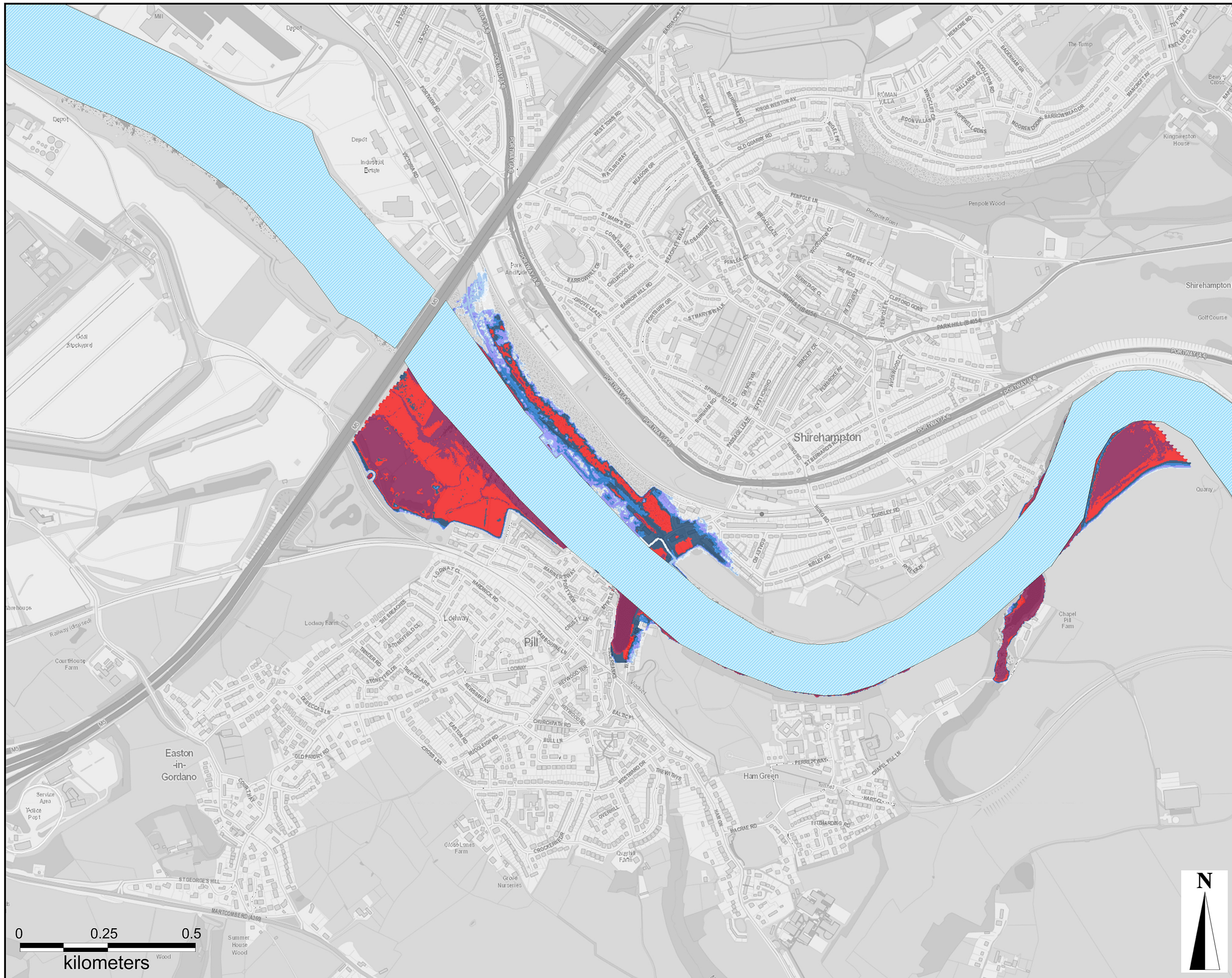
Scale at A3: 10,200

Drawing No: **Rev:**

FIGURE A-33 **1**

Drawn: Chk'd: App'd: **Date:**

RM MD JS June 2016



This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM in writing. AECOM accepts no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:



LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m

Model Reference:

CAFRA_132_200yr_F002_T200_2065

Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

PILL & SHIREHAMPTON
RUN ID 34 - DO MINIMUM
200 YR RETURN PERIOD
2065
MAXIMUM FLOOD DEPTH

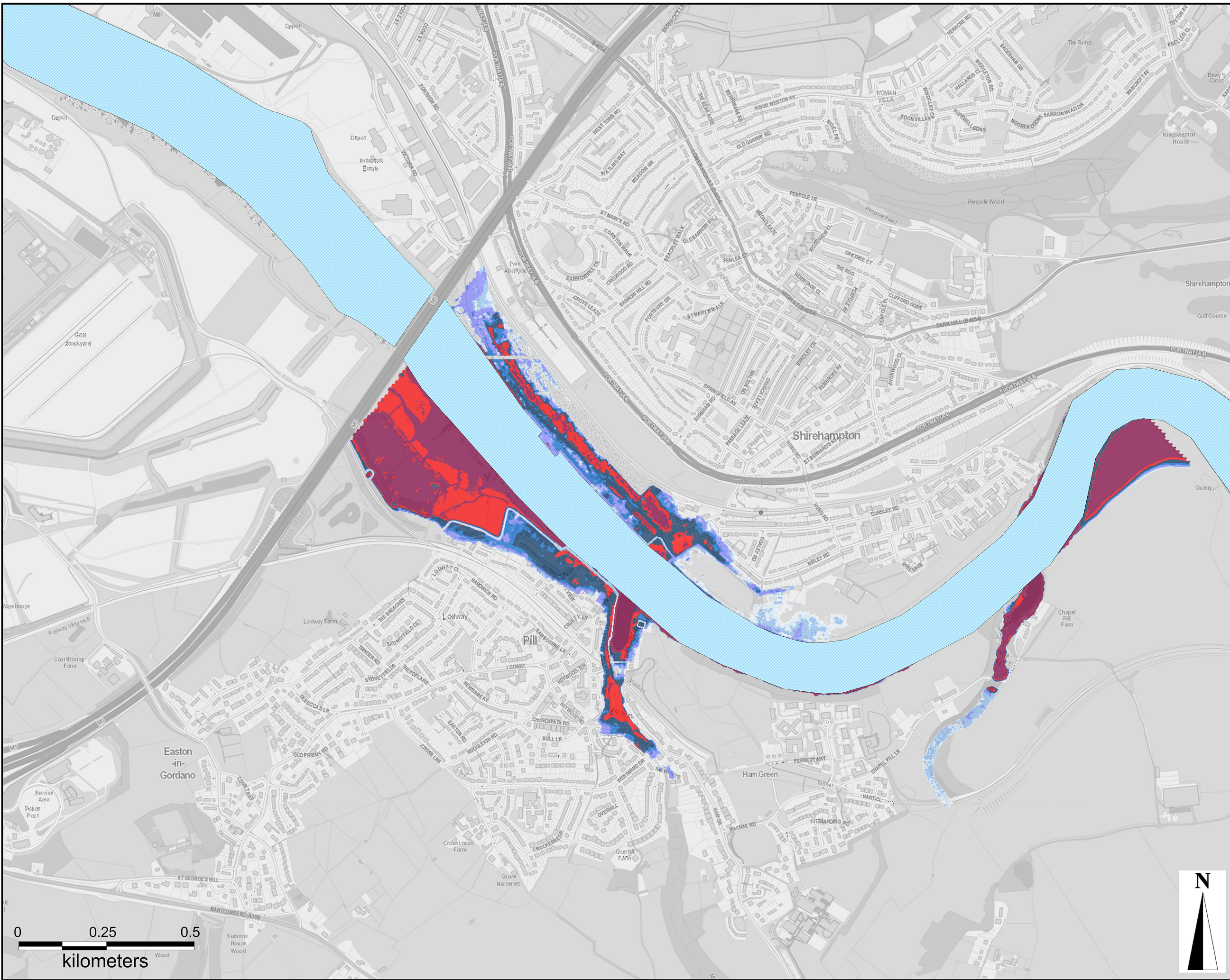
Scale at A3: 10,200

Drawing No: **Rev:**

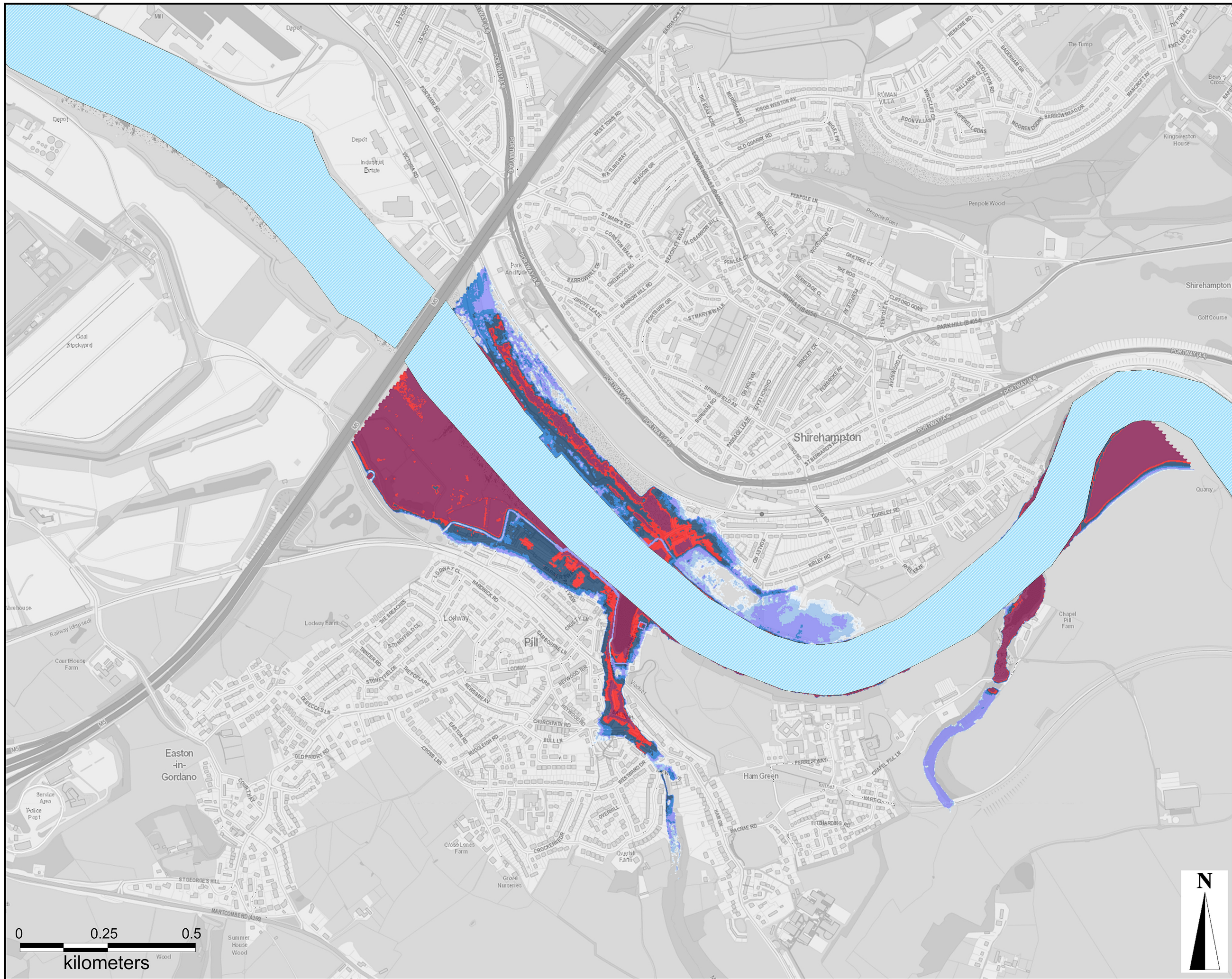
FIGURE A-34 1

Drawn: Chk'd: App'd: **Date:**

RM MD JS June 2016



This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the related dimensions.



Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:



LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m

Model Reference:

CAFRA_132_1000yr_F012_T1000_2065

Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

PILL & SHIREHAMPTON
RUN ID 35 - DO MINIMUM
1000 YR RETURN PERIOD
2065
MAXIMUM FLOOD DEPTH

Scale at A3: 10,200

Drawing No: **Rev:**

FIGURE A-35 1

Drawn: Chk'd: App'd: **Date:**

RM MD JS June 2016

This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM. AECOM accepts no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:

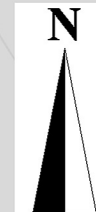
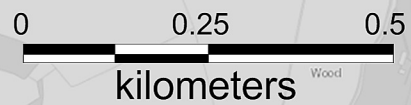
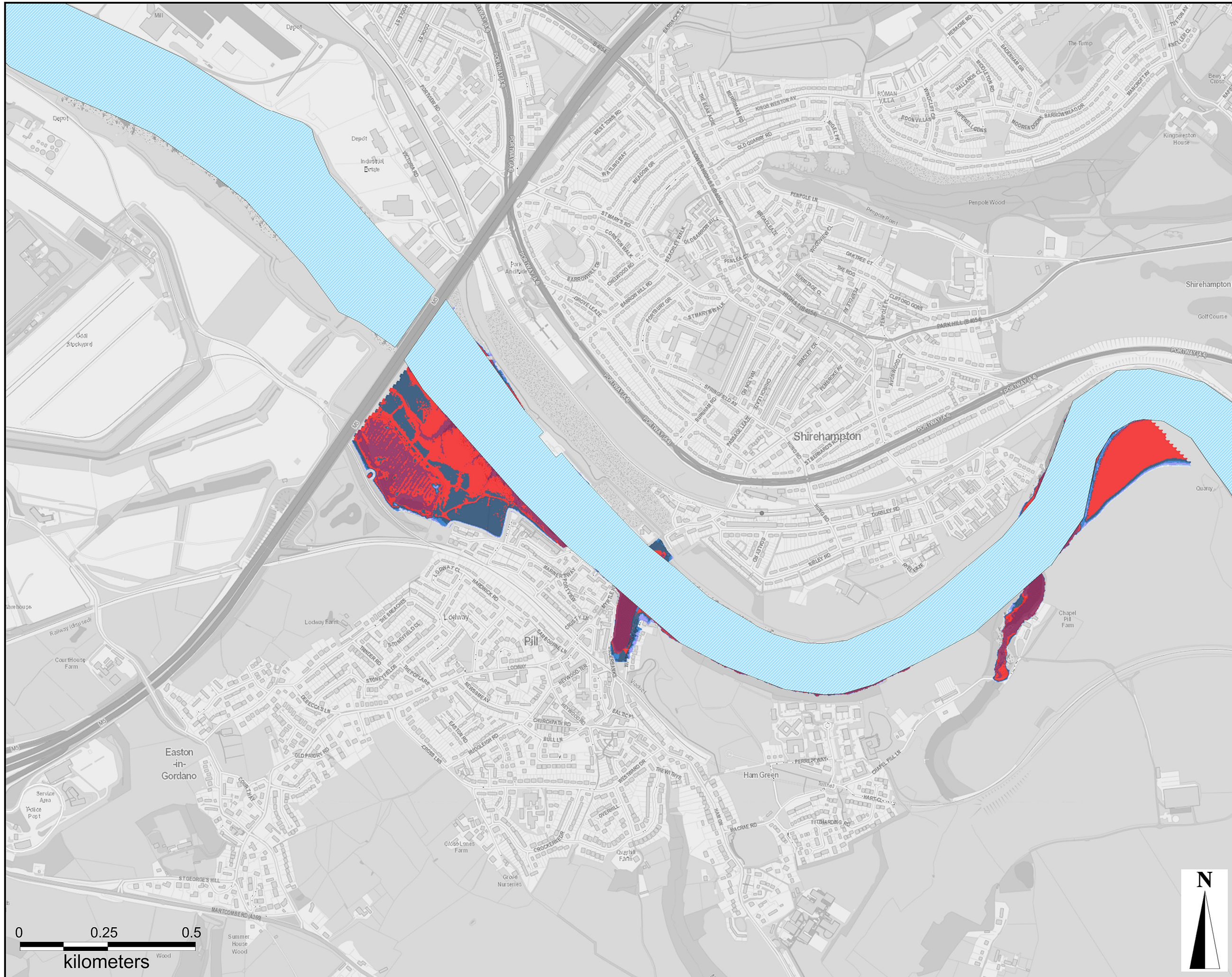


LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m



Model Reference:

CAFRA_132_2yr_FBASE_T002_2115

Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

PILL & SHIREHAMPTON
RUN ID 36 - DO MINIMUM
2 YR RETURN PERIOD
2115
MAXIMUM FLOOD DEPTH

Scale at A3: 10,200

Drawing No: **Rev:**

FIGURE A-36 **1**

Drawn: Chk'd: App'd: **Date:**

RM MD JS June 2016

This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM, accept as required by law. AECOM accepts no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:



LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m

Model Reference:

CAFRA_132_20yr_FBAS0_T020_2115

Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

PILL & SHIREHAMPTON
RUN ID 37 - DO MINIMUM
20 YR RETURN PERIOD
2115
MAXIMUM FLOOD DEPTH

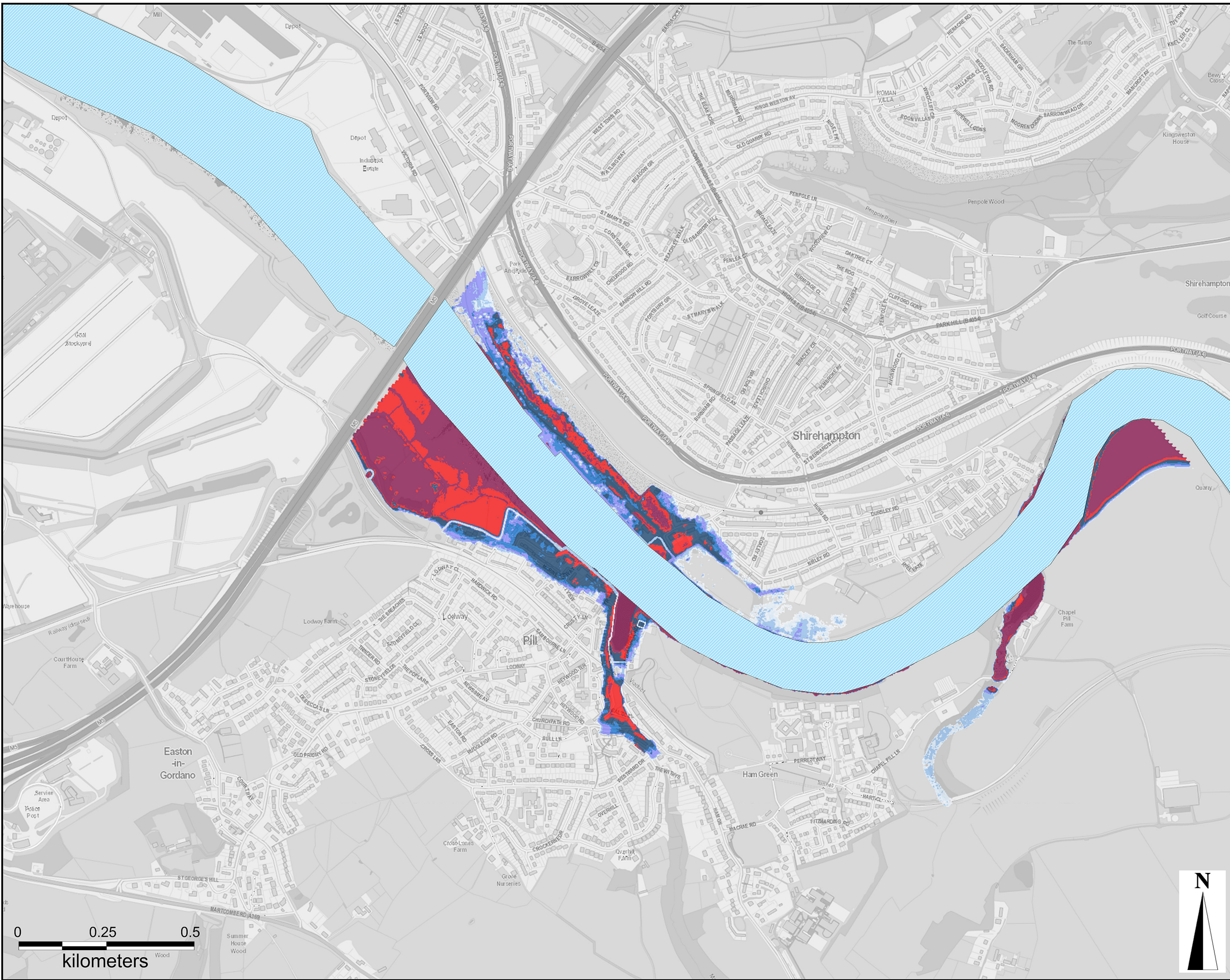
Scale at A3: 10,200

Drawing No: **Rev:**

FIGURE A-37 1

Drawn: Chk'd: App'd: **Date:**

RM MD JS June 2016



This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the related dimensions.

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:



LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m

Model Reference:

CAFRA_132_75yr_FBASE_T075_2115

Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

PILL & SHIREHAMPTON
RUN ID 38 - DO MINIMUM
75 YR RETURN PERIOD
2115
MAXIMUM FLOOD DEPTH

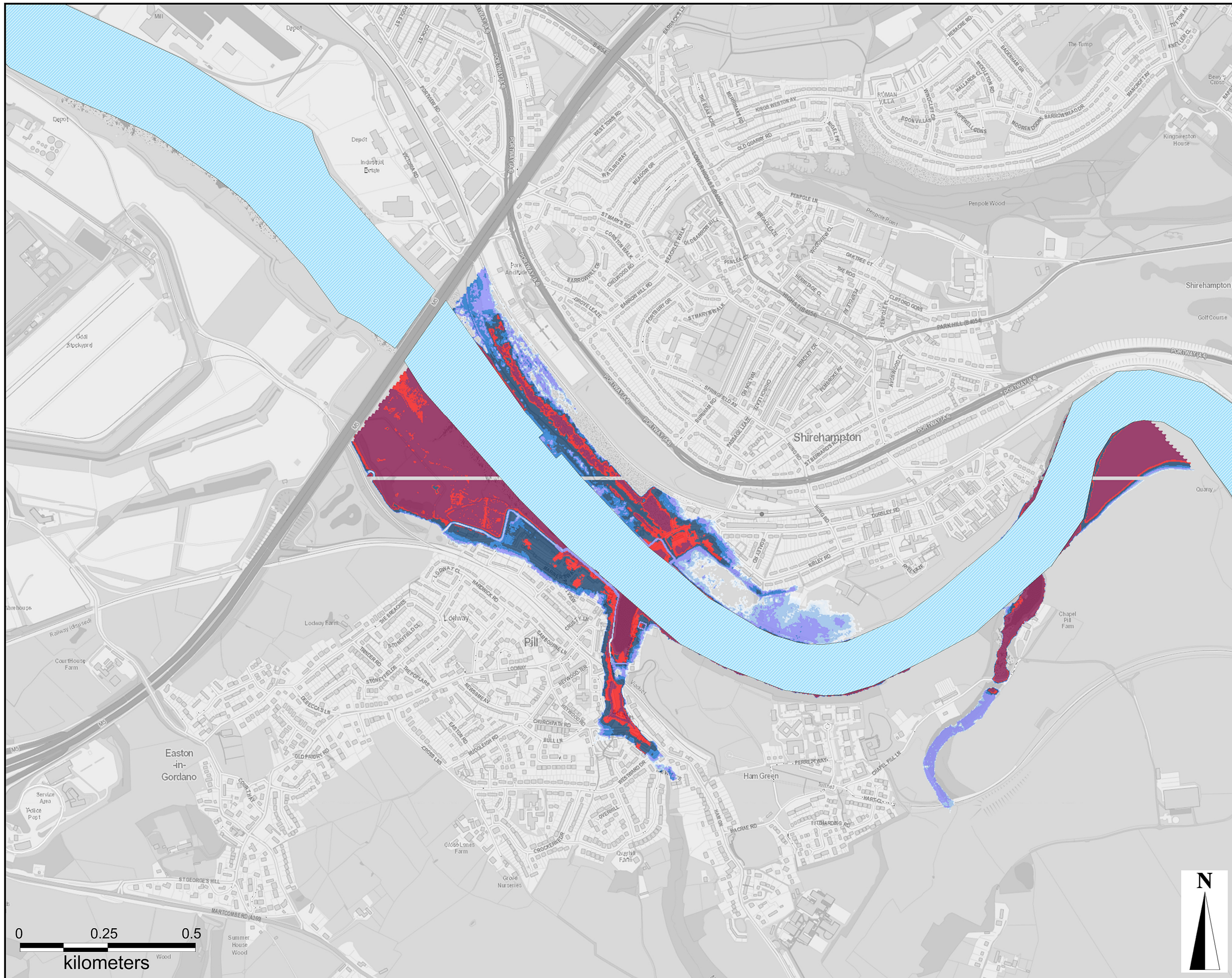
Scale at A3: 10,200

Drawing No: **Rev:**

FIGURE A-38 **1**

Drawn: Chk'd: App'd: **Date:**

RM MD JS June 2016



This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM. AECOM accepts no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:



LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m

Model Reference:

CAFRA_132_200yr_F002_T200_2115

Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

PILL & SHIREHAMPTON
RUN ID 39 - DO MINIMUM
200 YR RETURN PERIOD
2115
MAXIMUM FLOOD DEPTH

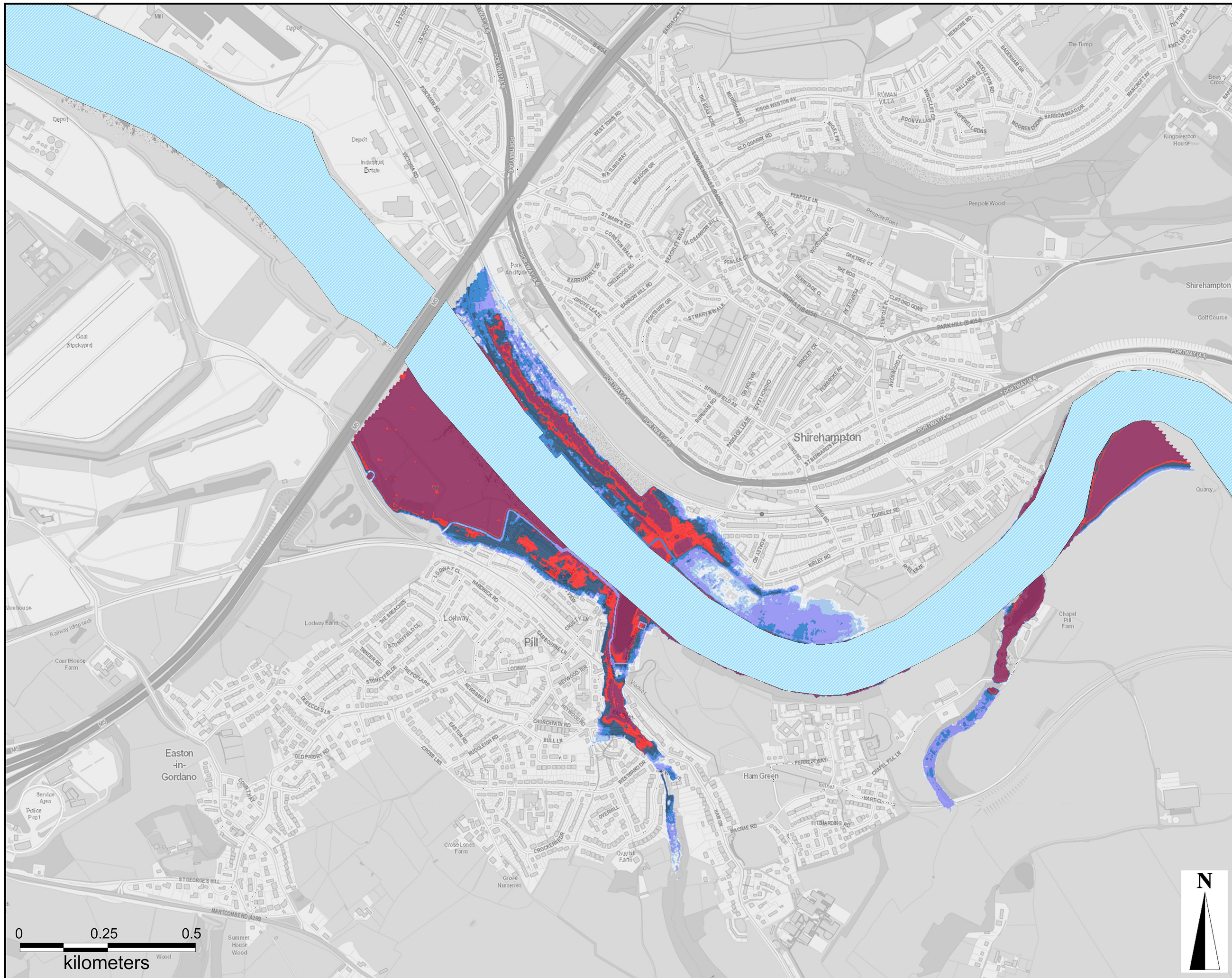
Scale at A3: 10,200

Drawing No: **Rev:**

FIGURE A-39 **1**

Drawn: Chk'd: App'd: **Date:**

RM MD JS June 2016



This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM. AECOM accepts no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:



LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m

Model Reference:

CAFRA_132_1000yr_F012_T1000_2115

Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

PILL & SHIREHAMPTON
RUN ID 40 - DO MINIMUM
1000 YR RETURN PERIOD
2115
MAXIMUM FLOOD DEPTH

Scale at A3: 10,200

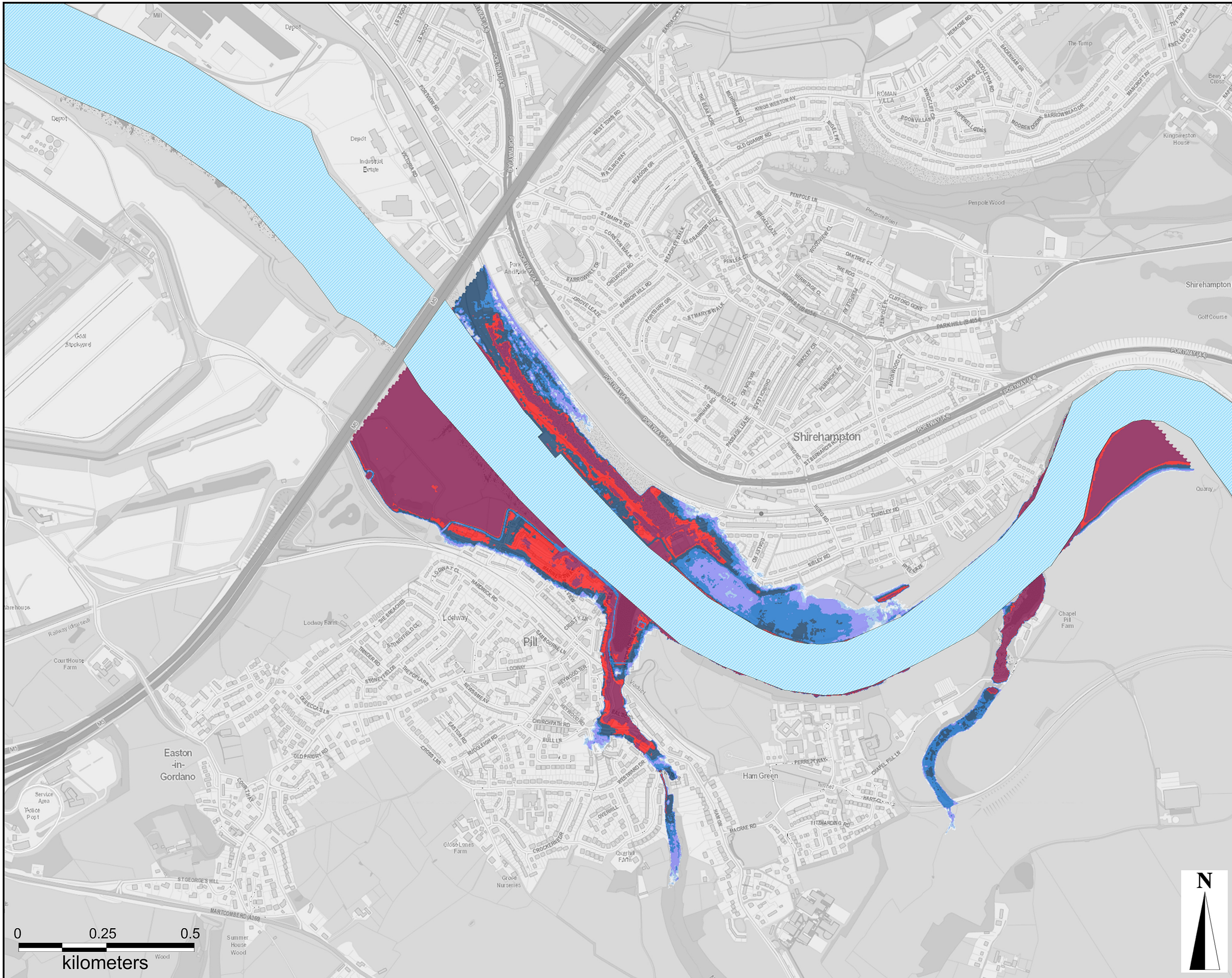
Drawing No: **Rev:**

FIGURE A-40

1

Drawn: Chk'd: App'd: **Date:**

RM MD JS June 2016



This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM. AECOM accepts no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

5.3 Appendix C: Pill / Shirehampton Do Something Flood Maps

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:

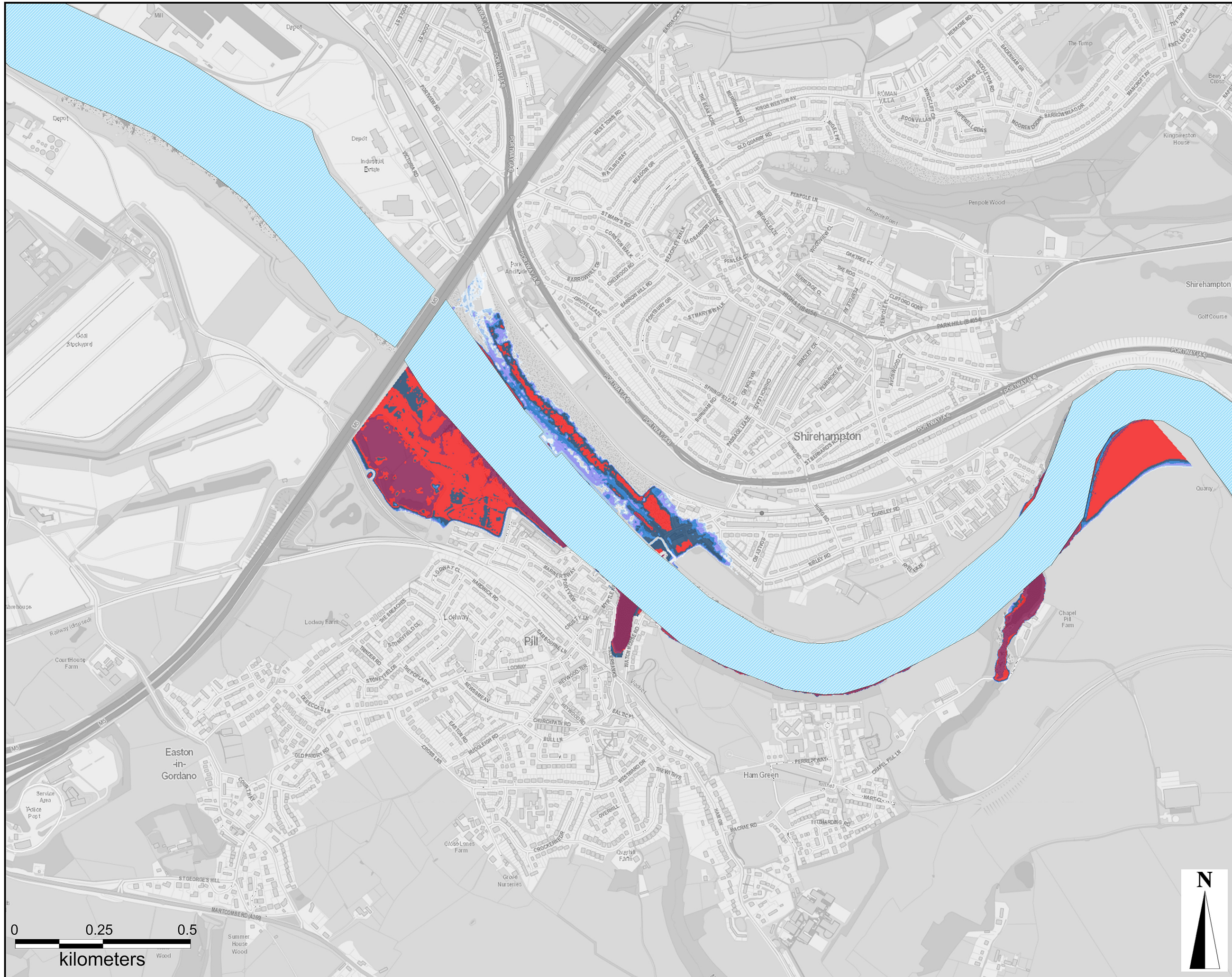


LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m



Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

LOW DEFENCES
PILL/SHIREHAMPTON
200 YR RETURN PERIOD
2015
MAXIMUM FLOOD DEPTH

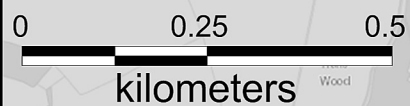
Scale at A3: 7,200

Drawing No: **Rev:**

RM MD JS August 2016

Drawn: Chk'd: App'd: Date:

RM MD JS August 2016



This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:

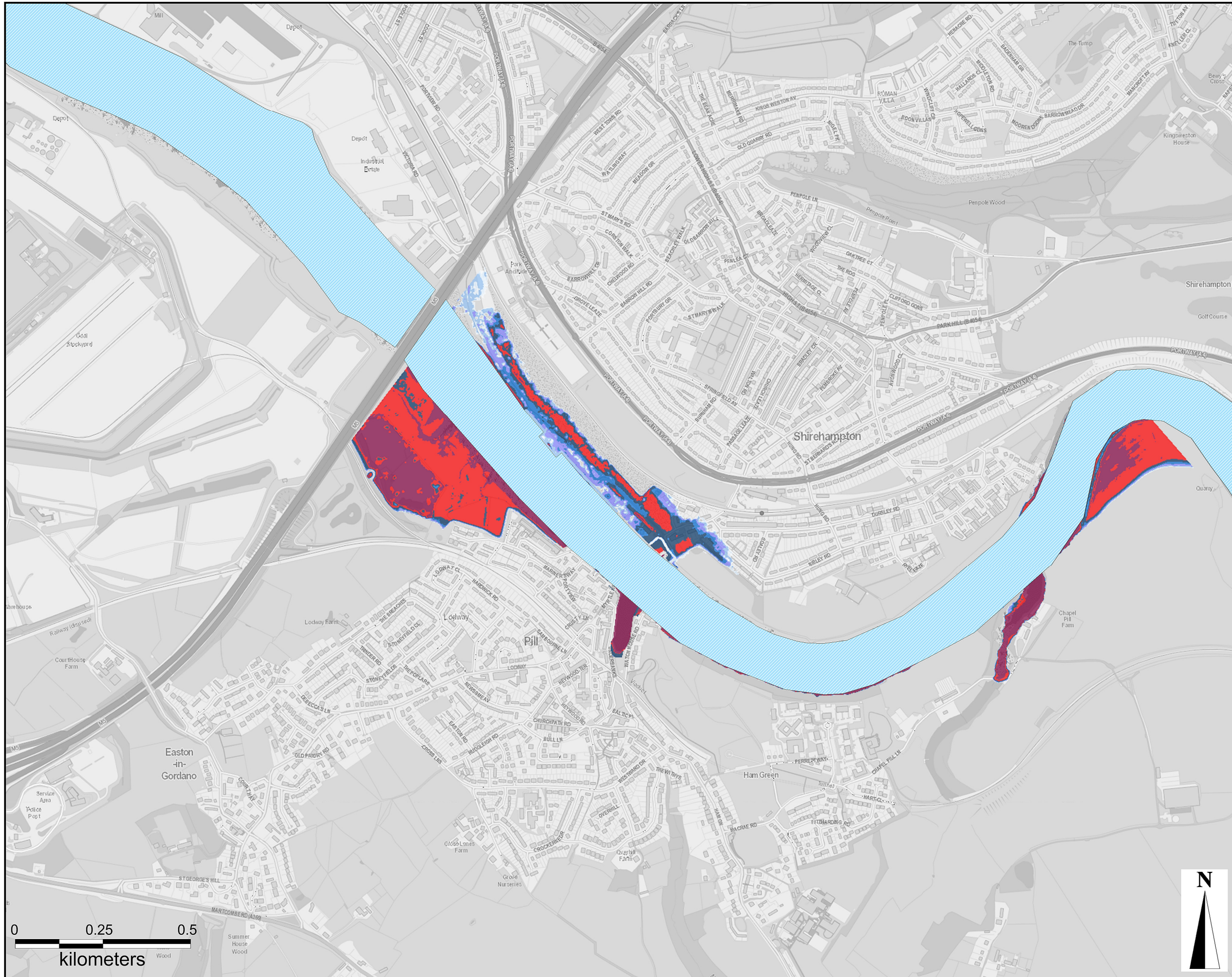


LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m



Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

LOW DEFENCES
PILL/SHIREHAMPTON
200 YR RETURN PERIOD
2030
MAXIMUM FLOOD DEPTH

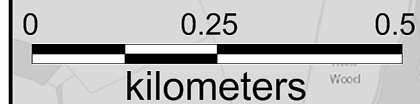
Scale at A3: 10,200

Drawing No: **Rev:**

RM MD JS August 2016

Drawn: **Chk'd:** **App'd:** **Date:**

RM MD JS August 2016



This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM. AECOM accepts no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:

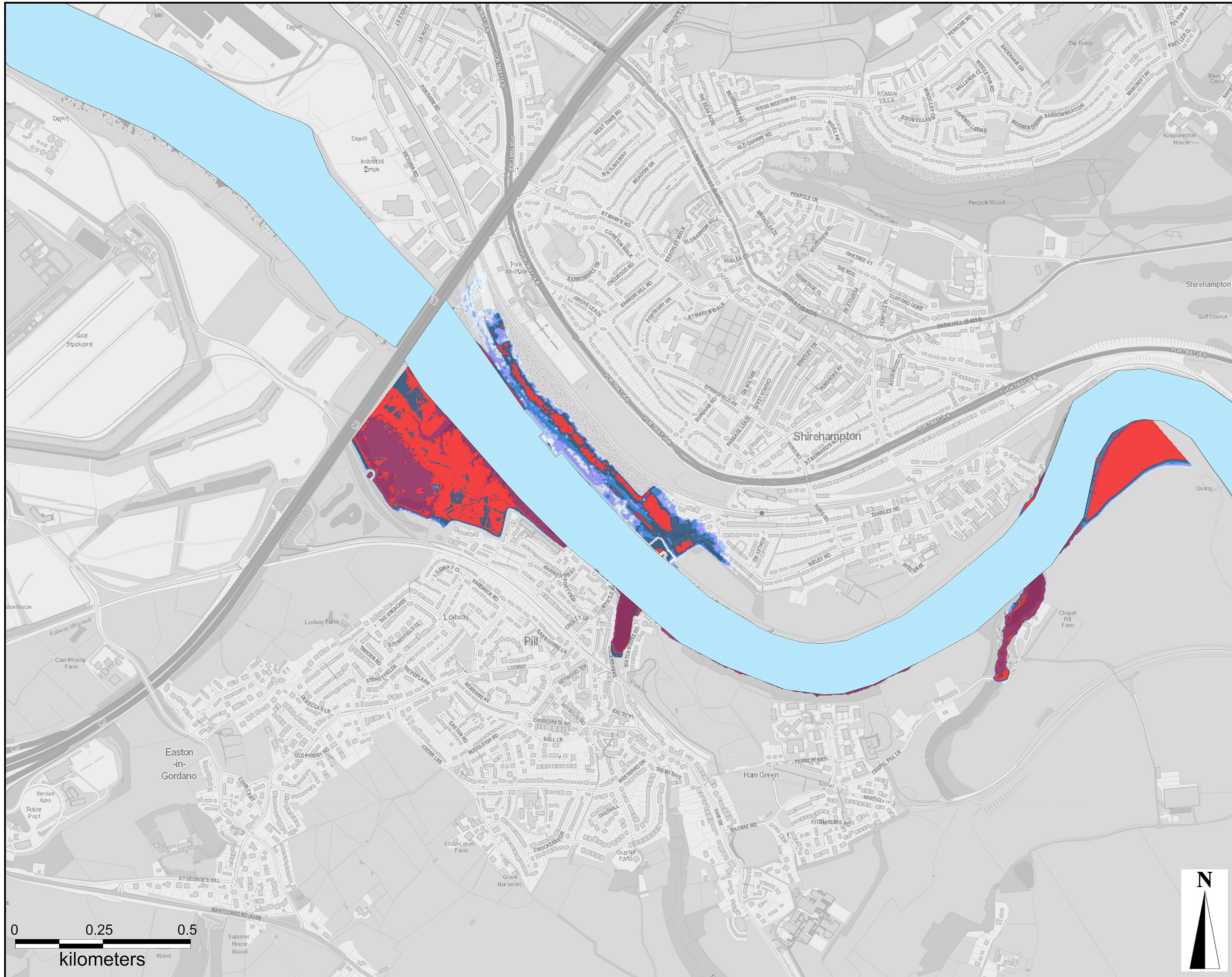


LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m



Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

LOW DEFENCES
PILL/SHIREHAMPTON
200 YR RETURN PERIOD
2015
MAXIMUM FLOOD DEPTH

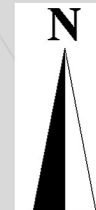
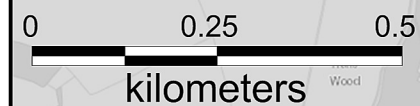
Scale at A3: 10,200

Drawing No: **Rev:**

RM MD JS August 2016

Drawn: Chk'd: App'd: Date:

RM MD JS August 2016



This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

Project Title:

RIVER AVON TIDAL
FLOOD RISK
MANAGEMENT
STRATEGY

Client:

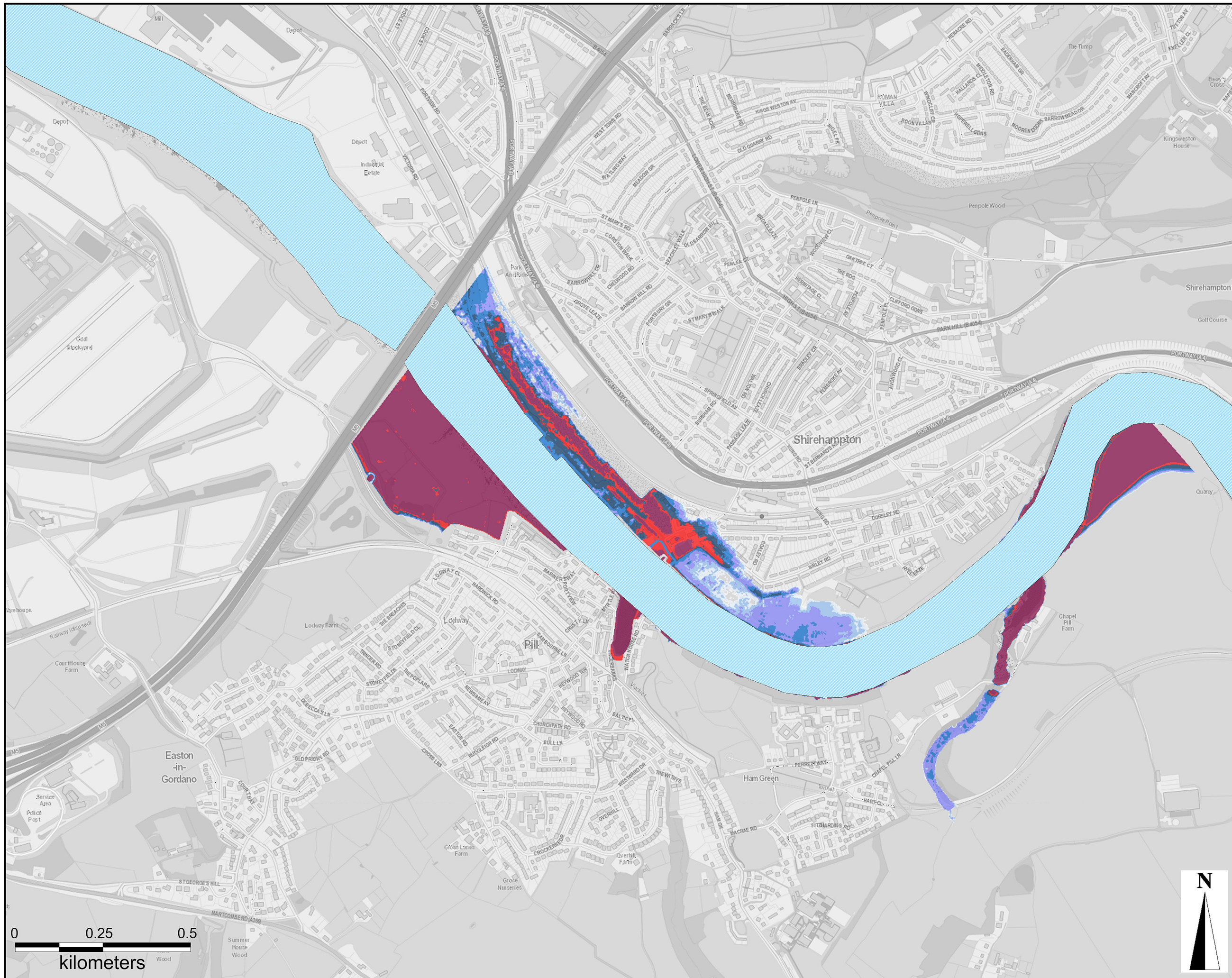


LEGEND

River Avon / Floating Harbour

Maximum Flood Depth

- 0.00m to 0.15m
- 0.15m to 0.30m
- 0.30m to 0.60m
- 0.60m to 0.90m
- 0.90m to 1.50m
- 1.50m to 2.00m
- >2.00m



Copyright:

OS data © Crown copyright & database rights 2016 Ordnance Survey 100023406

BCC data © Bristol City Council 2016

AECOM Internal Project No:

60478613

Drawing Title:

HIGH DEFENCES
PILL/SHIREHAMPTON
200 YR RETURN PERIOD
2115
MAXIMUM FLOOD DEPTH

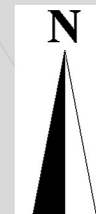
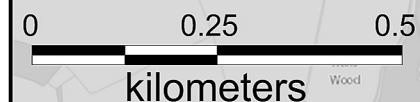
Scale at A3: 10,200

Drawing No: **Rev:**

RM MD JS August 2016

Drawn: Chk'd: App'd: Date:

RM MD JS August 2016



This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and disclaims any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.