HALL FARM, LODDON GARDEN VILLAGE SDL

ARBORFIELD CUT DIRECT RAINFALL MODELLING REPORT

UNIVERSITY OF READING

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1.0 Introduction

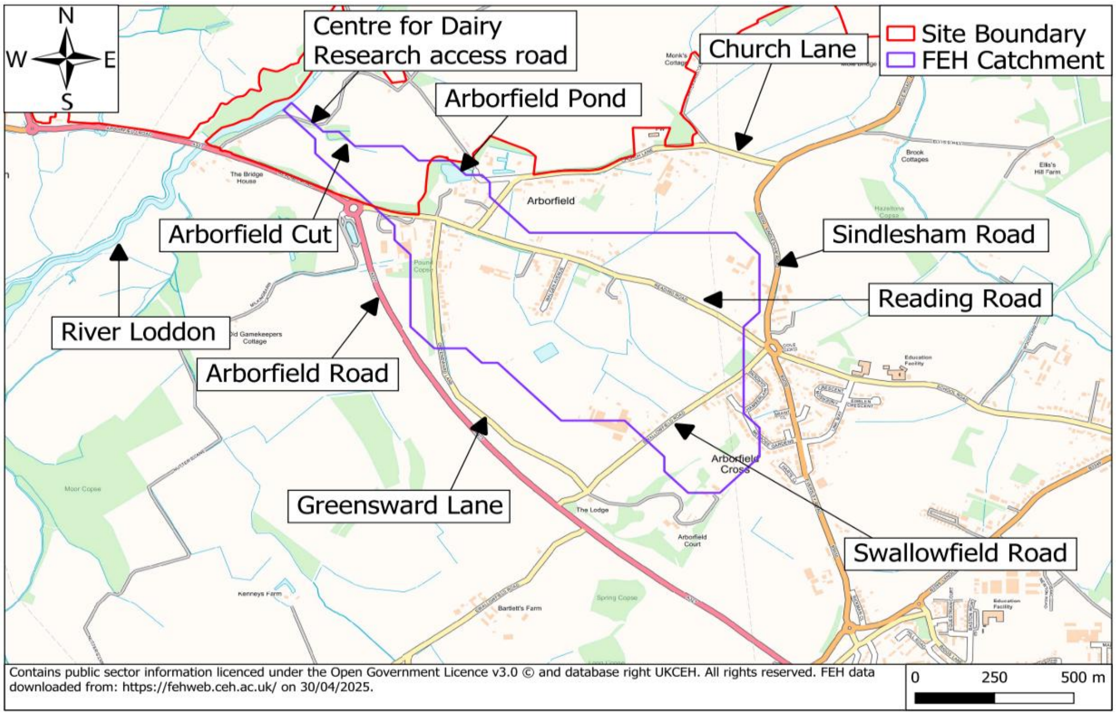
Background

1.1. This direct rainfall modelling report has been prepared by Abley Letchford, on behalf of the University of Reading for the Arborfield Cut in Berkshire.

1.2. This direct rainfall modelling report sets out the data and methods used to create a site-specific baseline model to represent the site-specific conditions. This report sets out the baseline model results to define the surface water flood extents.

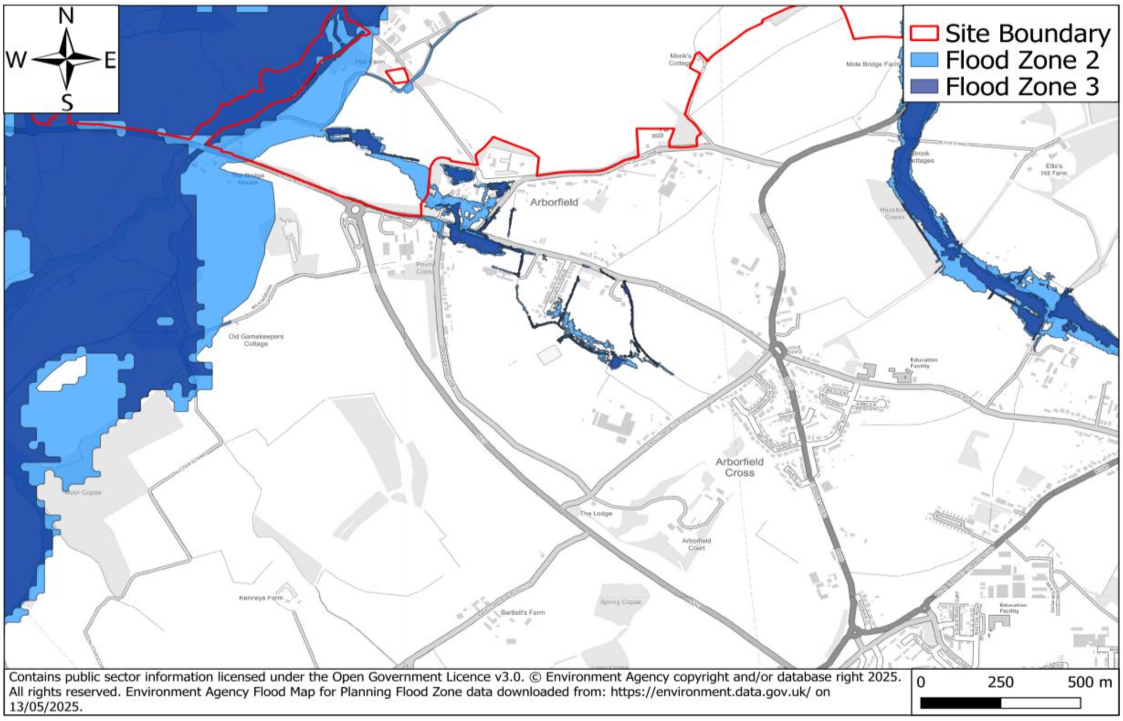
1.3. **Figure 1** shows the location of the site and catchment.

Figure 1 - Site Location Plan



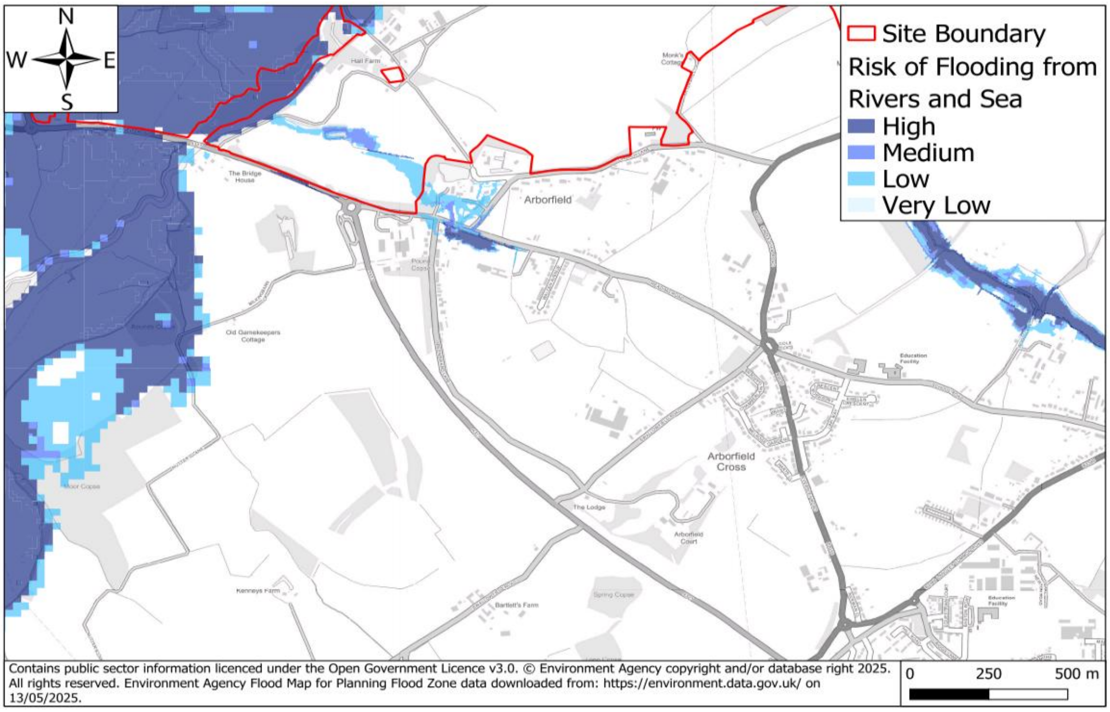
1.4. The Environment Agency (EA) Flood Map for Planning shows that the downstream part of the site is located within Flood Zones 2 and 3, dominated by flooding from the River Loddon, as show in **Figure 2**. There are areas of Flood Zone 2 and 3 along the Arborfield Cut. Some of these areas of flooding appear to be adjacent to the channel, rather than showing flooding within the Arborfield Cut. The flood extents will be reviewed and refined as part of this study.

Figure 2 – EA Flood Map for Planning



1.5. **Figure 3** shows the NaFRA Risk of Flooding from Rivers and Sea mapping.

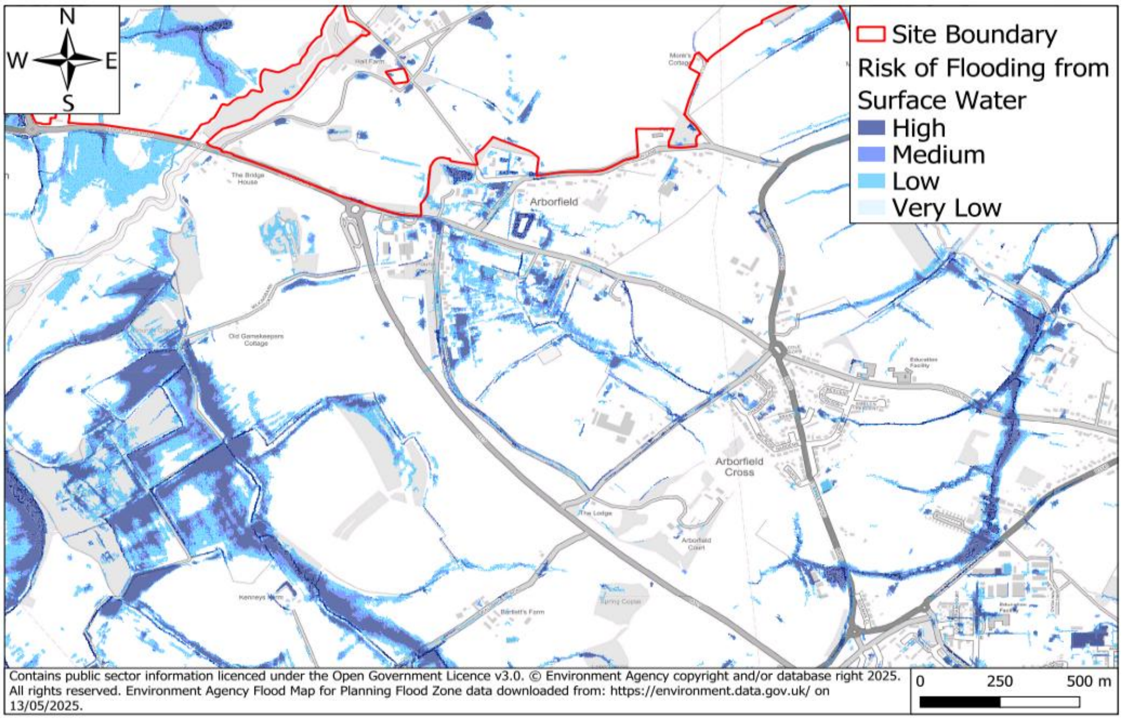
Figure 3 – NaFRA Risk of Flooding from Rivers and Sea



1.6. **Figure 3** shows a similar pattern of flooding to the EA Flood Map for Planning in **Figure 2**. Flooding is not shown along the ditches between Reading Road and Greensward Lane, as the NaFRA study separates out flooding from fluvial and surface water sources.

1.7. **Figure 4** shows the NaFRA Risk of Flooding from Surface Water extent.

Figure 4 – NaFRA Risk of Flooding from Surface Water



1.8. **Figure 4** shows that there is flooding along the ditches and low lying areas between Reading Road and Greensward Lane. **Figure 4** does not show any flooding along the Arborfield Cut as the NaFRA study separates out flooding from fluvial and surface water sources.

1.9. The key aim of this modelling study is to refine the flood extents using site specific information which considers the local features within the site and catchment in conjunction with local knowledge and site observations.

1.10. Scope

1.11. The scope of works includes the following:

- Undertake a hydrological assessment to estimate the catchment to the site and generate rainfall hyetograph for the relevant return periods.
- Build a new direct rainfall model with defined channels for the catchment using the best available data to refine the baseline surface water flood extents.
- Run the model for the following return periods; 1 in 30, 1 in 100, 1 in 1,000 annual probability scenarios.
- To assess the impact of climate change, the 1 in 100 annual probability scenario has been modelled with the most recent climate change allowances for the Loddon and Tributaries Management Catchment. A +40% climate change allowance has been applied for the 1 in 100 annual probability scenario which represents the Upper End peak rainfall allowance for the Loddon and Tributaries Management Catchment. The 40% climate change allowance has been applied to the rainfall.

2.0 Hydrological Assessment

2.1. Full details for the hydrological assessment methodology and application can be found in the Abley Letchford Hydrological Assessment in **Appendix** 1. A summary of the hydrological assessment is included within this chapter.

2.2. The hydrological study derived hyetograph estimates at key locations. A lumped catchment was obtained from the Flood Estimation Handbook (FEH) webservice and updated where appropriate.

2.3. The study derived hyetographs for the following return periods; 1 in 30, 1 in 100 and 1 in 1000 annual probability. To assess the impact of climate change, the 1 in 100 annual probability scenario was modelled with the most recent climate change allowances for the Loddon and Tributaries Management Catchment which is 40%. The 40% climate change allowance has been applied to the rainfall.

2.4. The hydrological analysis was completed using ReFH2 version 2.3.

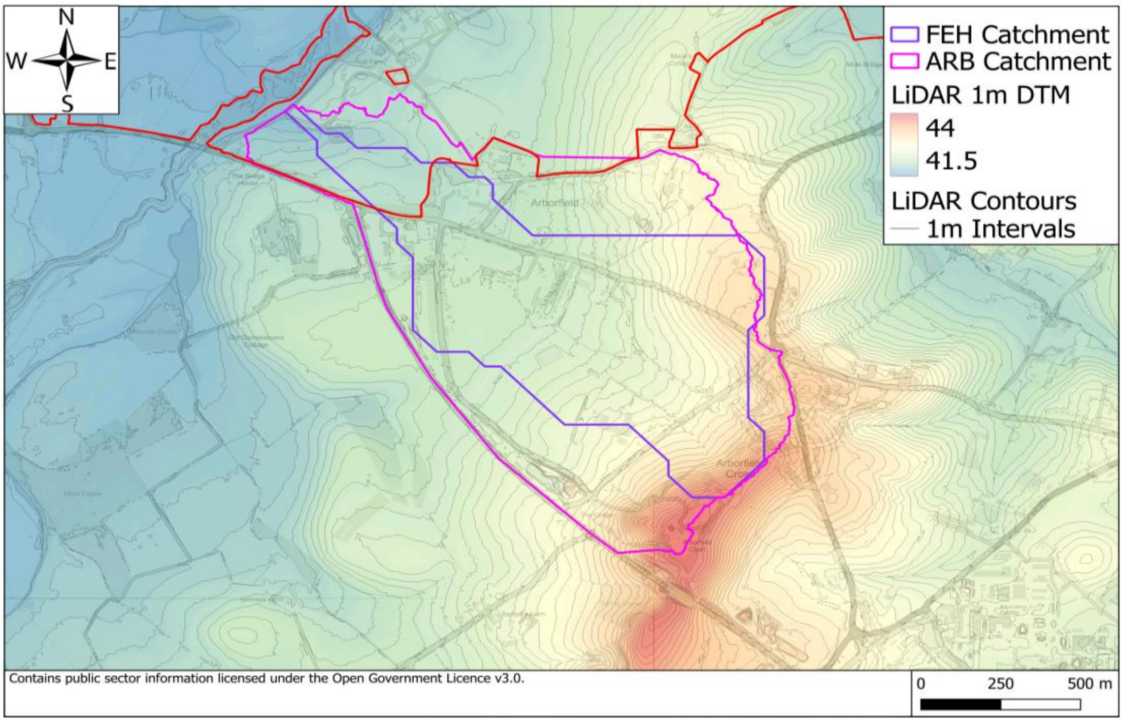
Hydrological Inflow Boundaries

2.5. The catchment was downloaded from the FEH Webservice.

2.6. The FEH catchment was adjusted using OS mapping, LiDAR data and a review of the EA indicative watershed dataset to derive the ARB catchment deemed to be most representative of the actual catchment. The FEH catchment area was 0.8km2. The ARB catchment has an area of 1.4km2.

2.7. **Figure 5** shows the extent of the FEH catchment and ARB catchment.

Figure 5 – FEH Catchment and Arborfield Cut (ARB) Catchment Extents



Catchment Descriptors

2.8. A review of the FEH Webservice catchment descriptors was carried out. A summary of key catchment descriptors and updates and summarised in **Table 1**. Further details of the checks and updates made to the catchment descriptors are provided below the table.

Table 1 – Catchment Descriptors

Catchment Descriptor	FEH Catchment Descriptor	ARB Catchment Descriptor
AREA	0.8	1.4
BFIHOST	0.357	0.517
BFIHOST19	0.409	0.471
DPLBAR	1.3	1.2
DPSBAR	19.4	19.4
FARL	0.99	0.99
FPEXT	0.12	0.12
LDP	2.12	2.12
PROPWET	0.29	0.29
SAAR	648	648
SPRHOST	40.87	42.34
URBEXT1990	0.091	0.120
URBEXT2000	0.088	0.120

Area

2.9. The FEH catchment area was adjusted for the ARB catchment using OS mapping, LiDAR data, the EA watershed dataset and observations from the site walkover. The FEH catchment area was 0.8km2. The ARB catchment area is 1.4km2.

BFIHOST and BFIHOST19

2.10. BFIHOST base flow index is a measure of catchment responsiveness based on the Hydrology of Soil Types (HOST) classification. It indicates the relationship between soil types and the runoff response. Permeable soils and geology tend to yield a higher baseflow.

2.11. BFIHOST19 is an updated method of classifying BFIHOST which improves on the classification of rarer soil types.

2.12. The BFIHOST values were initially reviewed using the Cranfield Soils online viewer. The catchment area had increase and there was a different percentage area in each of the soil classes. It was therefore deemed necessary to complete a further review of the BFIHOST values.

2.13. The Cranfield Soil Site Report was obtained and used to inform the updated BFIHOST value for the catchment.

2.14. The BFIHOST19 value was updated from 0.409 to 0.471.

SPRHOST

2.15. SPRHOST is the standard percentage runoff associated with each HOST soil class.

2.16. The SPRHOST values were initially reviewed using the Cranfield Soils online viewer. The catchment area had increase and there was a different percentage area in each of the soil classes. It was therefore deemed necessary to complete a further review of the SPRHOST values.

2.17. The Cranfield Soil Site Report was obtained and used to inform the updated SPRHOST value for the catchment.

2.18. The BFIHOST19 value was updated from 40.87 to 42.34.

PROPWET

2.19. PROPWET is a measure of the proportion of the time that the catchment soils are defined as wet. Wetter regions have higher PROPWET values. Dryer regions have lower PROPWET values. The PROPWET value for the FEH catchment is 0.29. The value is considered to be representative of the region that the ARB catchment is in.

FARL

2.20. FARL is a measure of the degree of flood attenuation provided by reservoirs and lakes within a catchment. A value of 1 represents the absence of lakes or reservoirs within the catchment. There are no lakes or reservoirs within the FEH catchment or the ARB catchment. There are a few ponds with the catchment. The FARL value of 0.99 is therefore considered to be representative for the ARB catchment.

URBEXT and URBEXT2000

2.21. URBEXT and URBEXT2000 is an index of the concentration of urban and suburban areas in 1990 and 2000 respectively expressed as a fraction.

2.22. OS mapping and aerial photography was reviewed for the ARB catchment and the URBEXT2000 value adjusted to reflect the suburban areas within the ARB catchment. The URBEXT2000 value was updated using the FEH Volume 5 Equation 6.2.

2.23. The URBEXT2000 value was adjusted to 0.12 to reflect the urban and suburban development within the ARB catchment.

SAAR

2.24. SAAR is a measure of the average annual rainfall between 1961 and 1990 in millimetres. The FEH catchment is adjacent to the HE01 catchment therefore both catchments will have received similar average rainfall. The SAAR value for the FEH catchment appears reasonable therefore it has been accepted for use for the ARB catchment.

DPSBAR

2.25. DPSBAR is an index for the overall catchment steepness. A value of greater than 300 represents mountainous regions. A value of less than 25 represents flatter regions. The DPSBAR value for the FEH catchment is 19.4. The FEH catchment and ARB catchment have a very similar slope therefore the DPSBAR for the sites is considered representative.

ReFH2 Method

2.26. The ReFH2 method was used to derive hyetographs for the ARB catchment. The ReFH2 method uses the FEH Webservice catchment descriptors to generate the design hyetographs for the return periods.

Storm Duration

2.27. The default ReFH2 rainfall parameters were applied. This approach is an industry standard approach. Rainfall parameters are not typically adjusted unless there is a specific reason to do so. These gave a storm duration of 5.5 hours and a timestep of 0.5 hours.

2.28. The ReFH2 Seasonal Correction Factor (SCF) of 0.67 was used. This was the ReFH2 default value. This approach is industry standard. Parameters are not typically adjusted unless there is a specific reason to do so.

2.29. The ReFH2 Areas Reduction Factor (ARF) of 0.98 was used. This was the ReFH2 default value. This approach is industry standard. Parameters are not typically adjusted unless there is a specific reason to do so.

Rainfall Estimates

2.30. The winter seasonality was selected. This is the appropriate storm profile for rural catchments in England, according to the ReFH2 guidance.

2.31. The site is located in the Loddon and Tributaries Management Catchment. The relevant climate change allowance is +40% which is the Upper End allowance.

Other Studies

2.32. Abley Letchford is aware of two other hydrological studies carried out of the Barkham Brook; the EA Lower Loddon Study completed by Jacobs on behalf of the EA in 2006 and the JBA Arborfield Cut modelling study, completed in 2023.

2.33. The Abley Letchford hydrological assessment report included within **Appendix 1**, considers the methods used within the other studies and sets out why the Ablet Letchford method has been accepted.

3.0 Model Approach and Input Data

Model Approach

3.1. A direct rainfall model with defined channels was constructed using TUFLOW (2025.0.2-iDP-w64).

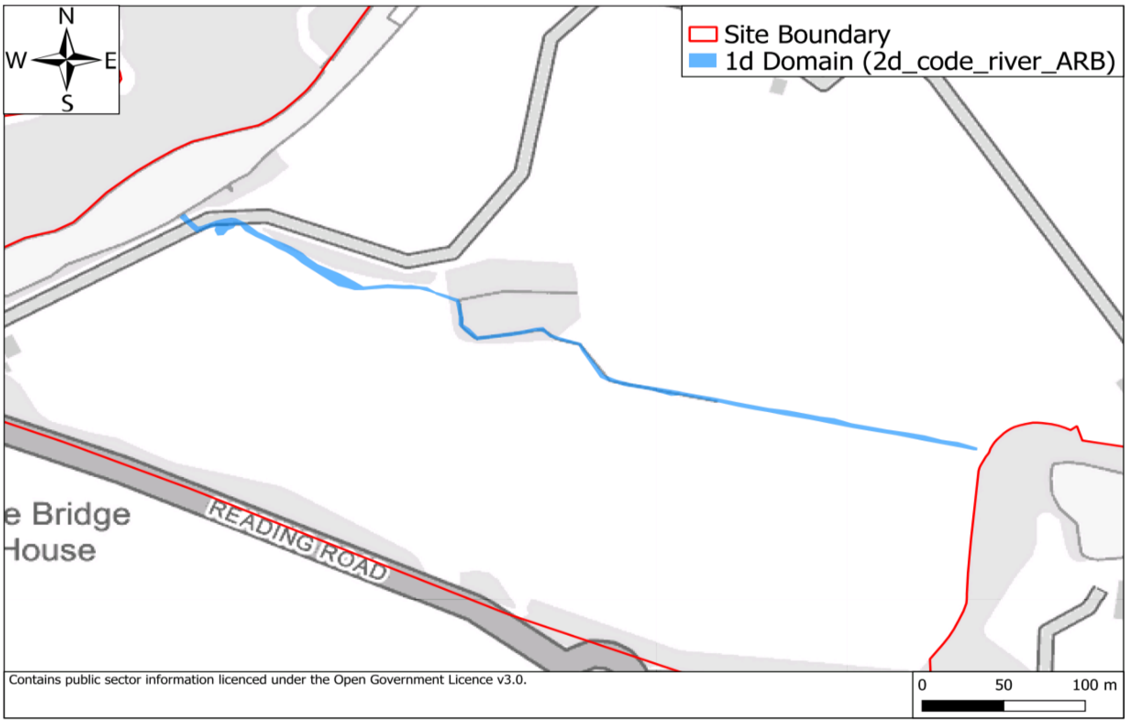
3.2. Double precision TUFLOW was used, as is recommended in the TUFLOW manual for direct rainfall models.

3.3. The model log is included in **Appendix 2.**

Model Domains

3.4. **Figure 6** shows the 1D model extent.

Figure 6 – 1D Model Extent



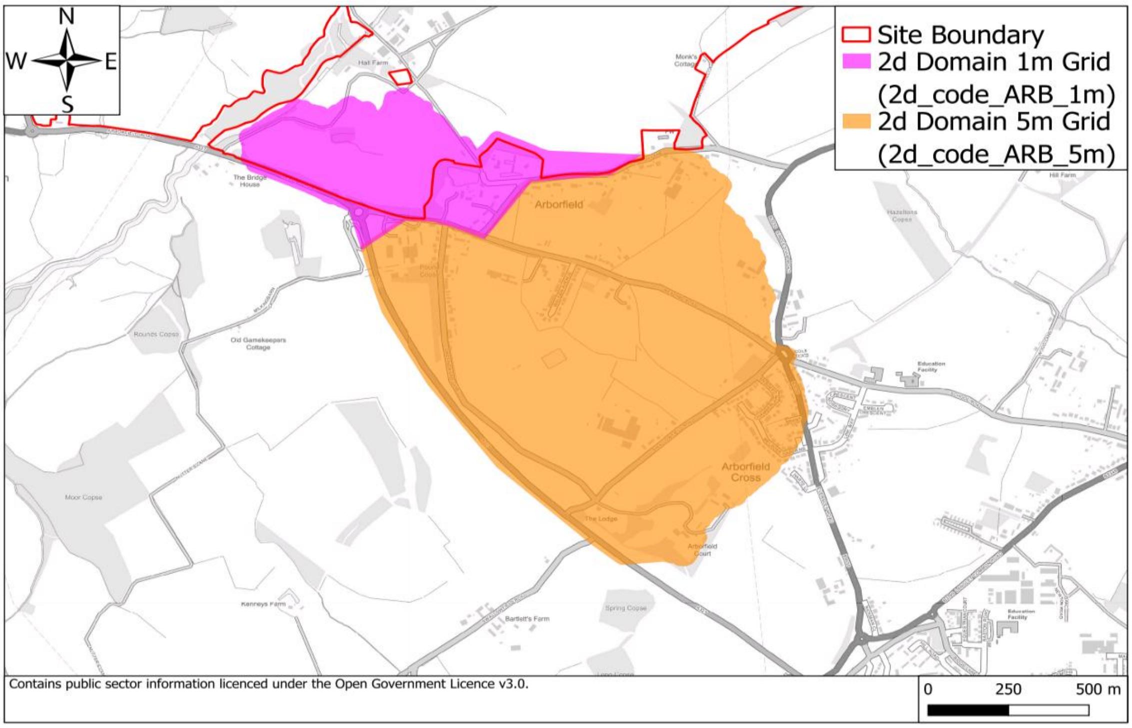
3.5. **Figure 7** shows the 2D model extent. There are two 2D model domains.

3.6. The coarse 2D model area is 1.3km2. The fine 2D model area is 0.3km2.

3.7. The coarse model domain grid size is 5m. The fine model domain grid size is 1m.

3.8. The model domain was set slightly larger than the catchment to ensure that there was no 'glass walling' of flow along the edges of the model.

Figure 7 – 2D Model Extent



Input Data

3.9. The latest available software and data has been used in the hydraulic model. The data is summarised below.

Hydraulic Software and Data

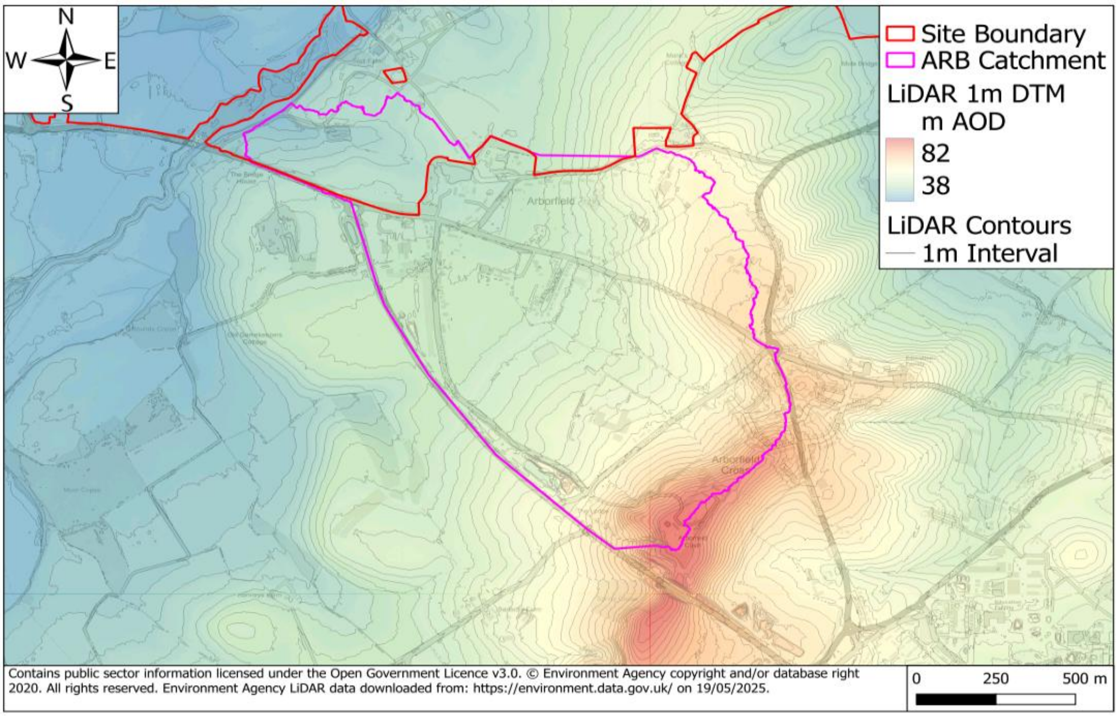
3.10. TUFLOW version 2025.0.2-iDP-w64 was used. These are the latest versions of the software.

3.11. The hydrological inflows were updated using ReFH2 version 2.3. This is the latest versions of the software.

LiDAR Data

3.12. 1m DTM LiDAR flown in 2020 and 2021 was used. This is the best available data at the finest available resolution. The LiDAR data was downloaded from the Defra open-source data service platform on 6th March 2025. **Figure 8** shows the extent of the LiDAR available for the site.

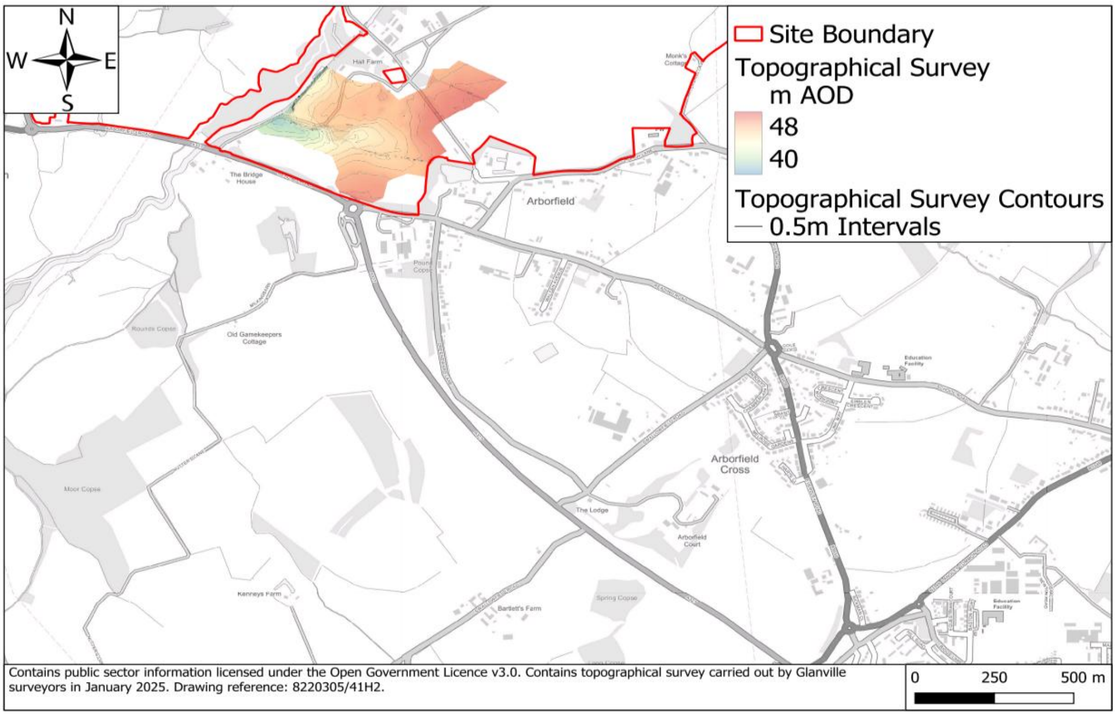
Figure 8 – EA LiDAR Coverage



Ground Model Data

3.13. A topographic survey of the site was carried out by Glanville surveyors in January 2025. The extent of the topographic survey is shown in **Figure 9**. A copy of the full topographic survey in appended in **Appendix 3**.

Figure 9 – Topographical Survey of the Site



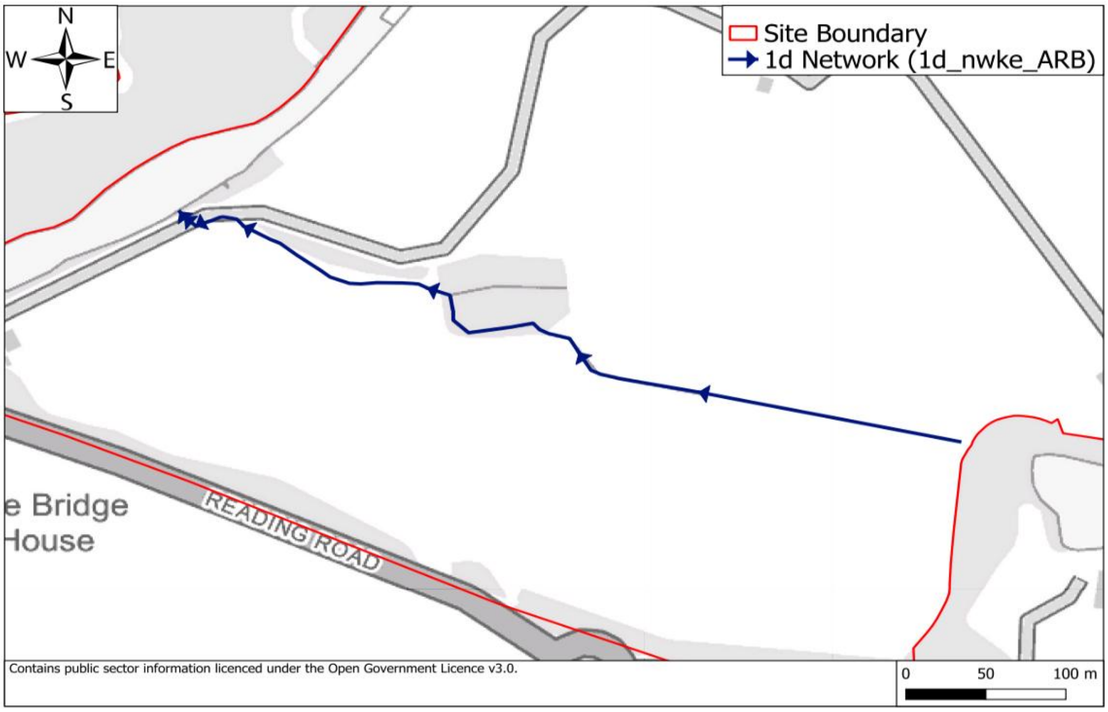
3.14. The Glanville survey data has been used to inform the bank levels along the 1D2D model boundary. The topographical survey has not been used to inform the ground elevations across the model as there was disagreement between the LiDAR and topographical survey levels which misrepresented the surface water extents at the edge of the topographic survey.

1D Model Domain

3.15. The channel sections in the 1D model domain taken from channel survey carried out of Arborfield Cut by Infomap in February 2023. There are 6 open channel sections and 1 culvert in the model.

3.16. **Figure 10** shows the location of the 1D channel sections.

Figure 10 – 1D Channel Section Location

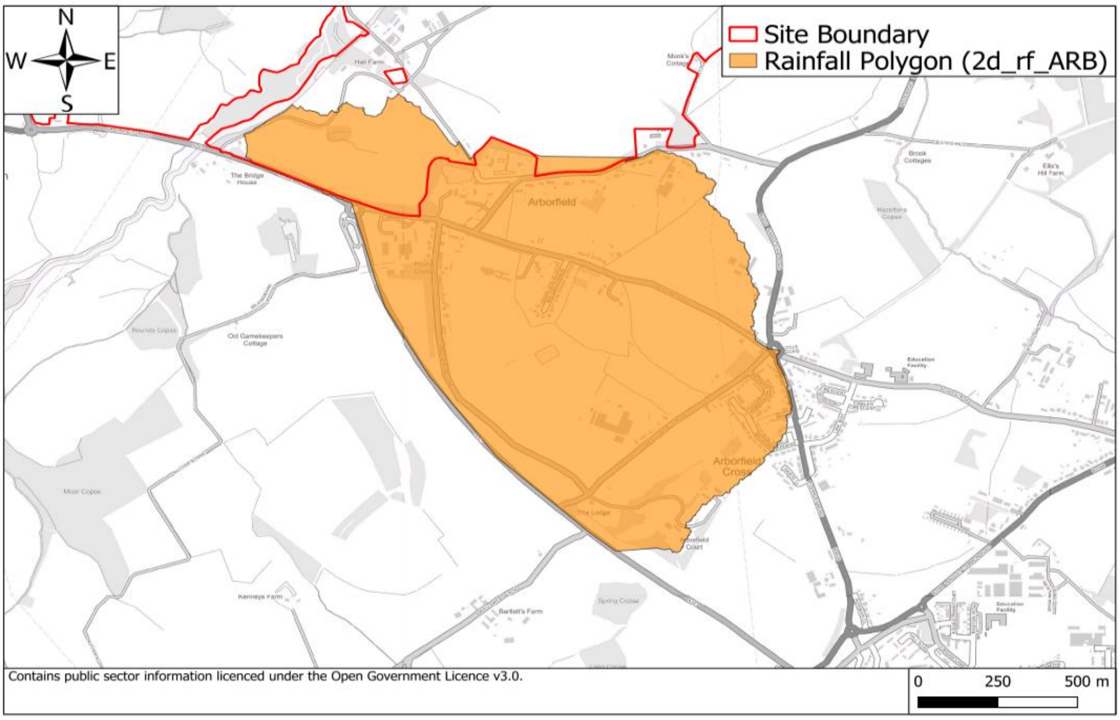


Inflow Boundaries

3.17. The net rainfall calculated by ReFH2 was added to the model using a 2d_RF boundary across the ARB catchment. The RF represents the net rainfall.

3.18. **Figure 11** shows the extent of the rainfall input.

Figure 11 – Rainfall Input Location

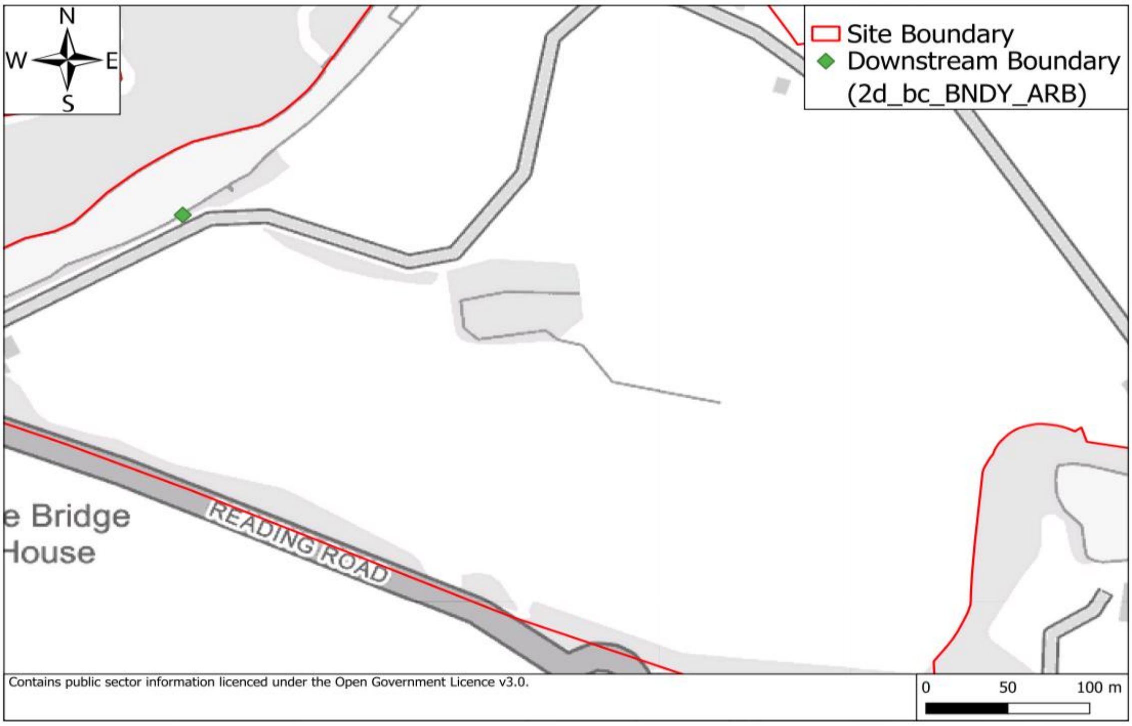


Downstream Boundary

3.19. The downstream boundary of the model has been set at the confluence of Arborfield Cut with the River Loddon. A 2d_bc boundary was used to set the downstream boundary of the model at the 1 in 100 annual probability flood level of the Stantec 2021 River Loddon peak flood level of 40.79m AOD.

3.20. **Figure 12** shows the location of the downstream boundary within the model.

Figure 12 – Downstream Boundary of the Model Domain



Roughness

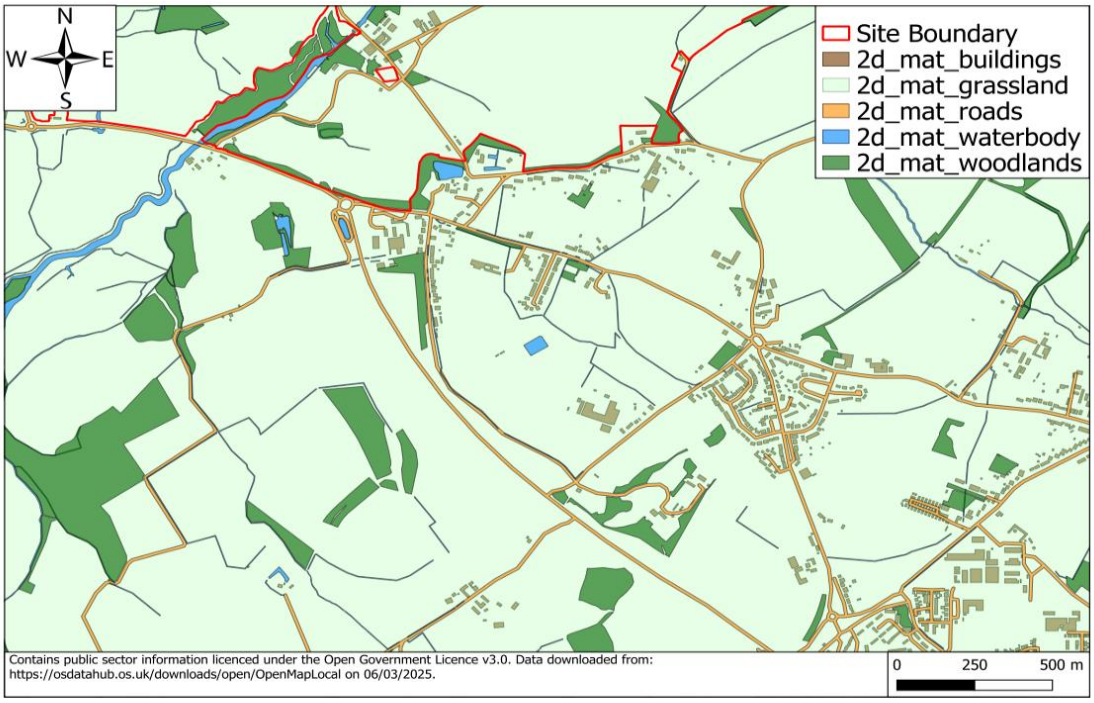
3.21. The hydraulic roughness can impact the conveyance of flood within the floodplain.

3.22. Polygons were downloaded from eMapSite to inform the land use types. eMapSite uses OS mapping to classify the land use types.

3.23. Manning's 'n' roughness values were assigned to the land use types within the model domain using Chow 1959 industry standard guidance, satellite imagery of the site, photographs from a site walkover and professional judgement.

3.24. Roughness values were applied using 2d_mt files within the .tmf file. **Figure 13** shows the location of each material layers.

Figure 13 – Materials Layers



3.25. **Table 2** summarises the land use types, and roughness values selected. The Manning's 'n' roughness values were taken from Chow, 1959.

Table 2 – Summary of Manning's 'n' Roughness Values

ID	Description	Manning's 'n' Roughness Value
1	Grassland	0.06
2	Roads and Pavements	0.022
3	Buildings	1
4	Waterbodies	0.03
5	Woodland and Natural Environment	0.10

3.26. A high Manning's 'n' value of 1 was used to represent the building locations within the model and direct flow around the buildings.

Structures in the 2D Domain

3.27. No structures have been included within the 2D domain.

1D/ 2D Domain Links

3.28. The 1D in-channel and 2D floodplain components of the model are connected along the tops of the banks using HX lines.

3.29. The Glanville survey data has been used to inform the bank levels along the 1D2D model boundary.

1D/ 2D Bank Level Representation

3.30. Topographical survey data was used to inform the bank level representation.

Model Layers

3.31. **Table 3** summarises the layers used within the model domain.

Table 3 – 2D Model Layers

Layer	Purpose
1d_nwke_ARB	Defines the location of the 1d channel and structures.
1d_xs_ARB	Defines the 1d channel geometry.
1d_WLL_ARB	WLL interpolate the 1d water levels across the 1d domain.
2d_code_5m_ARB	Defines the coarse 2d model extent.
2d_code_1m_ARB	Defines the fine 2d model extent.
2d_code_river_ARB	Defines the 1d model extent.
2d_bc_BNDY_ARB	Defines the floodplain boundary.
2d_bc_hxi_ARB	Defines the link between the 1d and 2d model domains.
2d_bc_2D2D_ARB	Defines the link between the 2d model domains.
2d_rf_ARB	Applies a rainfall hyetograph to the defined polygon.
2d_zsh_ARB_P	Points defining levels along the zsh line which informs the bank levels.
2d_zsh_ARB_L	Line informing the bank location. The levels are taking from the zsh points layer.
2d_loc_5m_ARB	Defines the model orientation.
2d_loc_1m_ARB	Defines the model orientation.
2d_mat_ARB_buildings	Defines the 2d roughness area for buildings.
2d_mat_ARB_grassland	Defines the 2d roughness area for the general surface and grassland
2d_mat_ARB_woodlands	Defines the 2d roughness area for the natural environment and woodlands.
2d_mat_ARB_roads	Defines the 2d roughness area for roads and paths.
2d_mat_ARB_waterbody	Defines the 2d roughness area for waterbodies.

Model Runs

3.32. The model was run for 7.5 hours.

3.33. The coarse model domain had a fixed 2D timestep of 2.5 seconds.

3.34. He fine 1D model domain had a fixed 1D timestep of 0.25 seconds and a fixed 2D timestep of 0.5 seconds.

3.35. The model was run for the following return periods:

- 1 in 30 annual probability;
- 1 in 100 annual probability;
- 1 in 1,000 annual probability; and

- 1 in 100 annual probability +40% climate change allowance.

3.36. The site is located within the Loddon and Tributaries Management Catchment. The relevant climate change allowance is the Upper End allowance which is +40% for this management catchment.

4.0 Sensitivity Testing

4.1. Sensitivity testing has been undertaken to assess the impact of uncertainty within the model and assumptions made.

Manning's 'n' Roughness

4.2. A 20% increase and decrease in the Manning's 'n' roughness estimations was modelled.

4.3. **Figure 14** and **Figure 15** shows the difference in the maximum flood extents for a ±20% increase and decrease in the Manning's 'n' roughness values.

Figure 14 – 1 in 100 Annual Probability +40% Climate Change Allowance Manning's Roughness Sensitivity 20% Increase

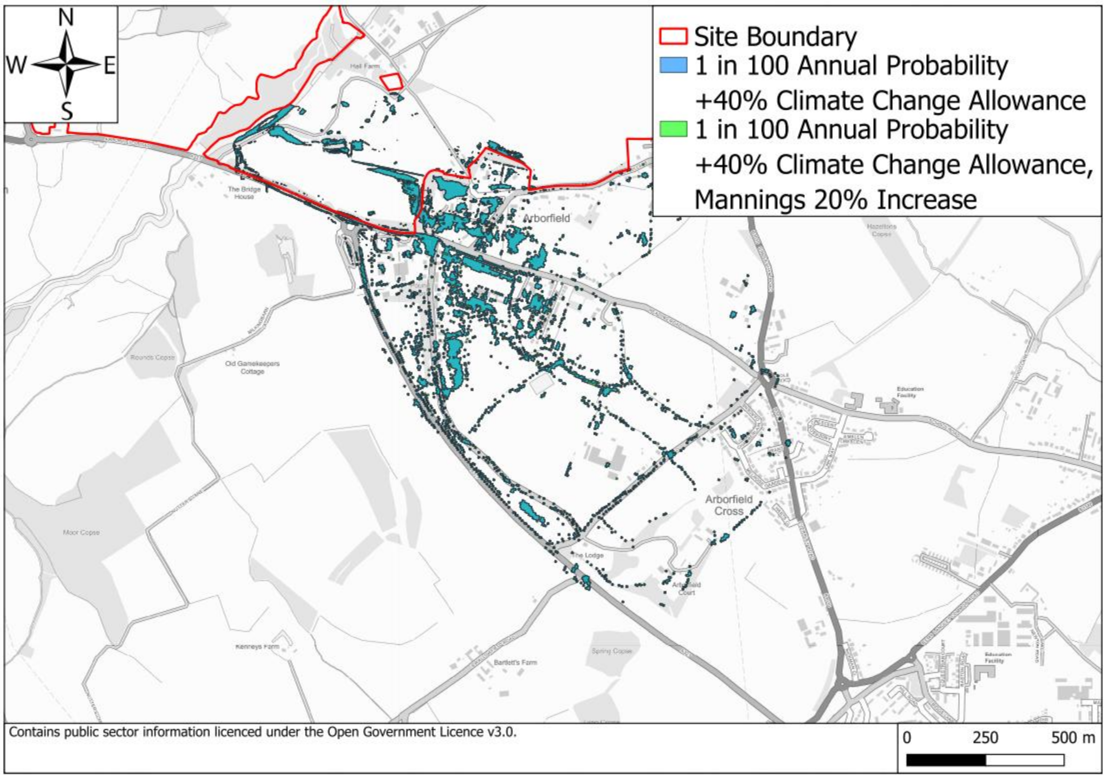
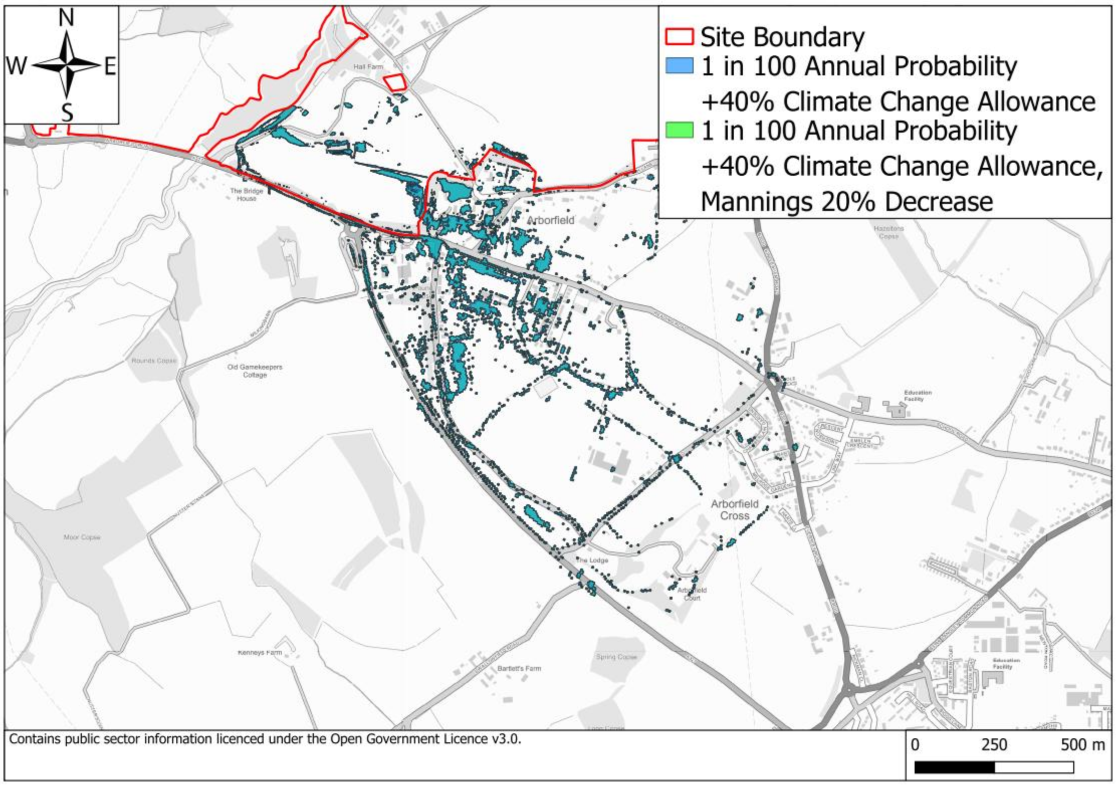


Figure 15 – 1 in 100 Annual Probability +40% Climate Change Allowance Manning's Roughness Sensitivity 20% Decrease



4.4. **Figure 14** shows that there is a slight increase in the modelled flood extents for the scenario with a 20% increase in the Manning's 'n' roughness. Flood levels have typically increased by less than 0.05m. This is as expected. However, the model is deemed to be insensitive to a 20% increase in the Manning's 'n' roughness values.

4.5. **Figure 15** shows that there is a slight decrease in the modelled flood extents for the scenario with a 20% decrease in the Manning's 'n' roughness. Flood levels have typically decreased by less than 0.03m. This is as expected. However, the model is deemed to be insensitive to a 20% decrease in the Manning's 'n' roughness values.

Culvert Blockage

4.6. A 50% and 90% blockage was applied to the culvert under the Centre for Dairy Research access track. **Figures 16** and **17** show the difference in the modelled maximum flood extents for a 50% and 90% blockage respectively.

Figure 16 – 1 in 100 Annual Probability +40% Climate Change Allowance 50% Culvert Blockage

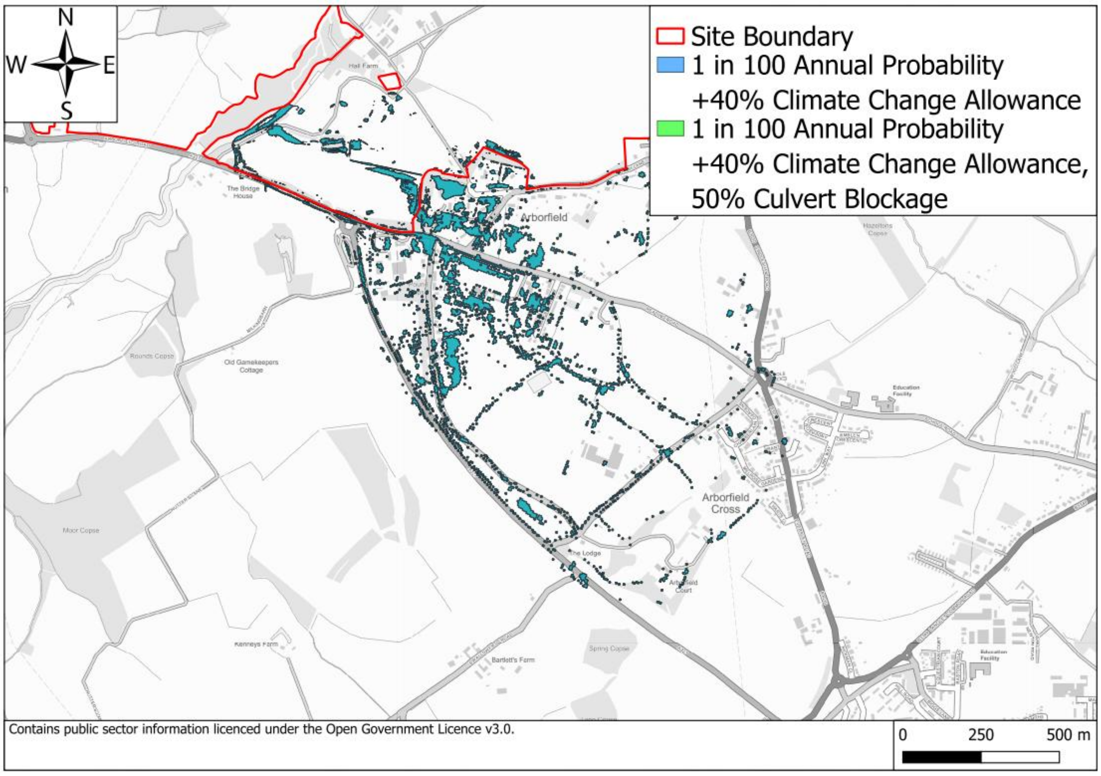
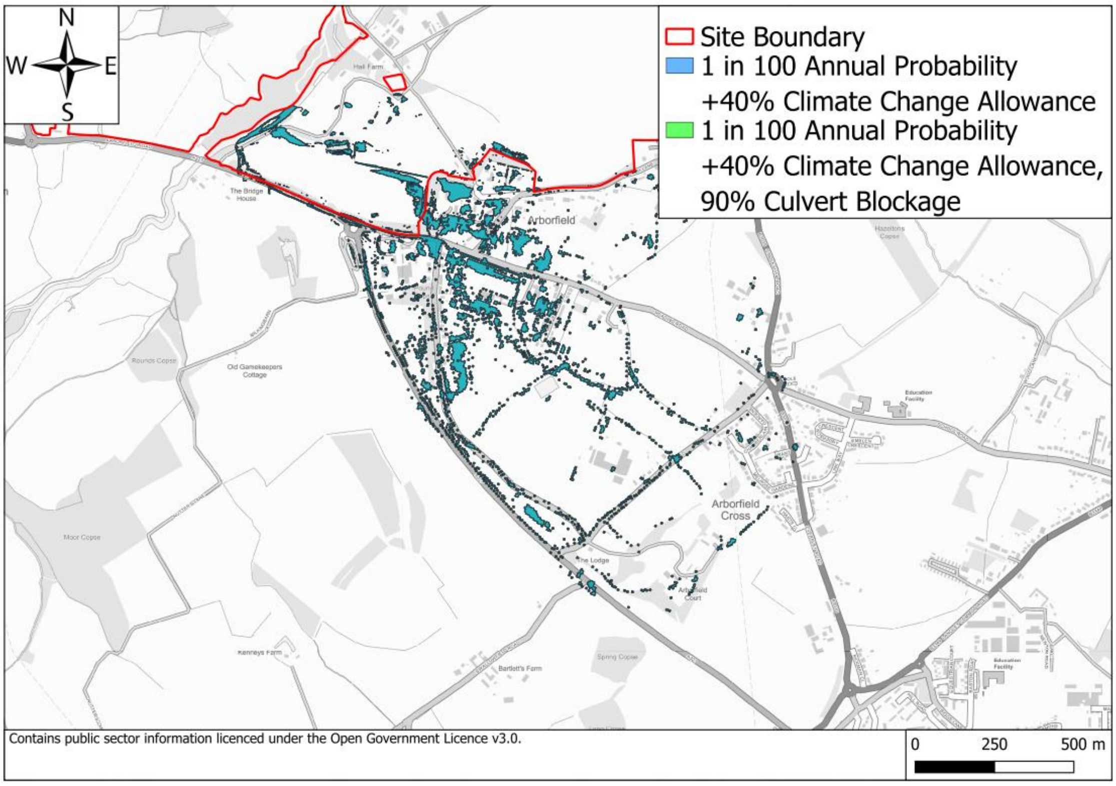


Figure 17 – 1 in 100 Annual Probability +40% Climate Change Allowance 90% Culvert Blockage



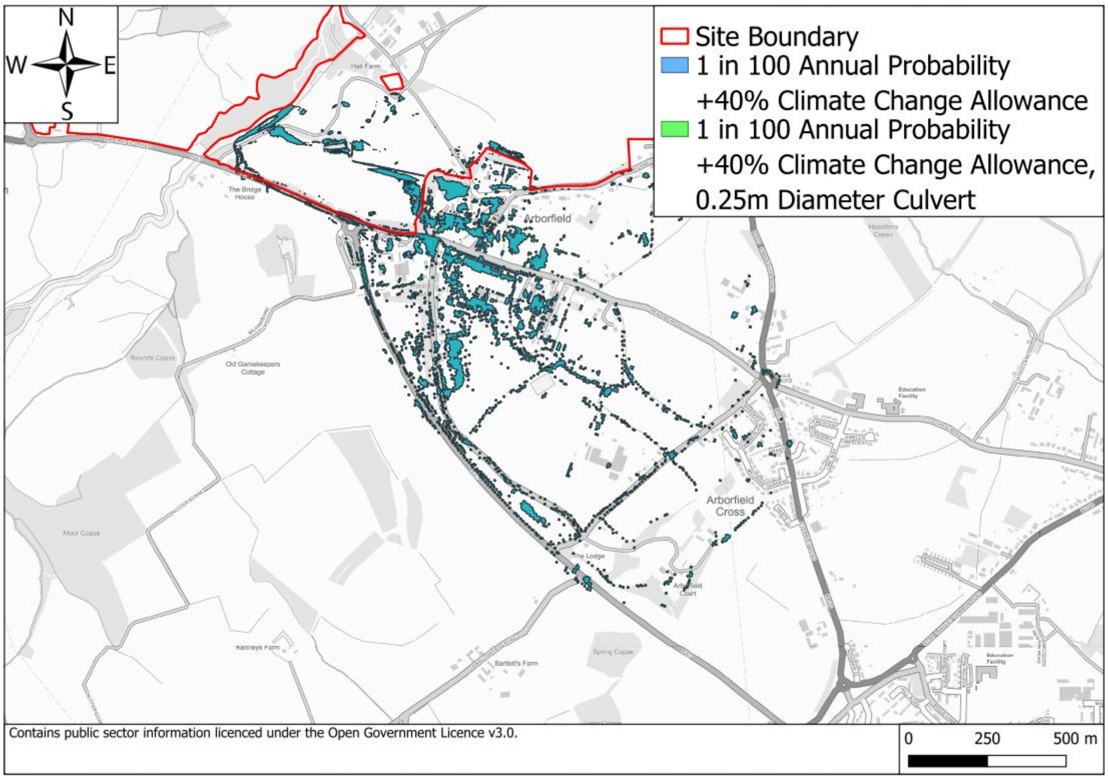
4.7. **Figure 16** and **Figure 17** shows that there is a slight increase in the modelled flood extents immediately upstream of the culvert, but the model is reasonably insensitive to the blockage in the culvert. The increase in modelled water levels is up to 0.01m and 0.012m for the 50% and 90% blockage scenarios respectively.

Culvert Diameter

4.8. The channel survey of the culvert under the Centre for Dairy Research showed different upstream and downstream pipe diameters. It is not possible to model this in software therefore a conservative approach was taken and then smaller, upstream, culvert diameter of 0.1m was selected for the baseline model. A sensitivity test using the larger, downstream, culvert diameter of 0.25m has been carried out.

4.9. **Figure 18** shows a comparison of the 1 in 100 annual probability +40% climate change allowance maximum flood extents for the 0.1m diameter culvert and the 0.25m diameter culvert under the Centre for Dairy Research access track.

Figure 18 – 1 in 100 Annual Probability +40% Climate Change Allowance Comparison between 0.1m and 0.25m Diameter Culverts under the Centre for Dairy Research Access Track



4.10. **Figure 18** shows that there is a slight decrease in the modelled flood extents immediately upstream of the culvert when a 0.25m diameter culvert is modelled, and a slight increase immediately downstream of the culvert. This is expected as more water is conveyed through the culvert. The difference is water level is less than 0.01m The results show that the model is reasonably insensitive to the assumption made within the modelling that the culvert has a 0.1m diameter culvert.

5.0 Model Results

Flood Extents

Overview

5.1. The model was run and the results were extracted for the following events:

- 1 in 30 annual probability;
- 1 in 100 annual probability;
- 1 in 1,000 annual probability; and
- 1 in 100 annual probability plus 40% climate change allowance.

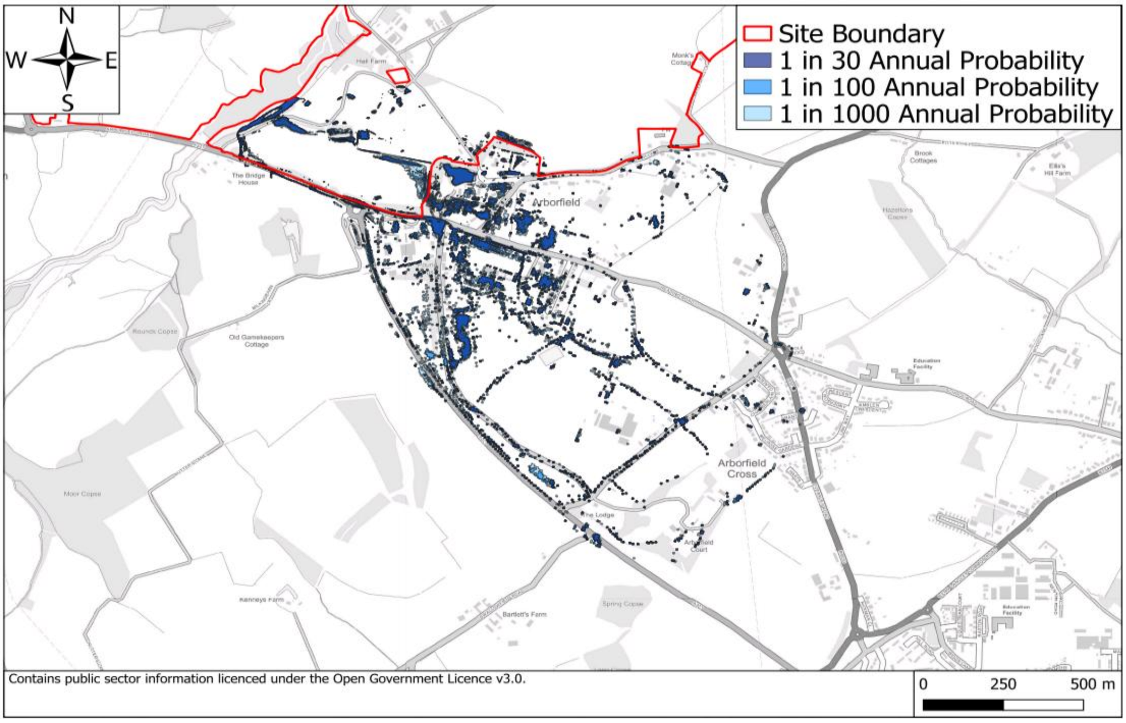
Summary of the Model Outputs

5.2. The model is a direct rainfall model. Due to the nature of direct rainfall models, the entire 2D model domain is shown to be wet in the raw model results (as rain falls across the whole model domain). The raw model results are filtered which removes all cells with flood depths below a certain depth to show areas of flooding and remove areas that are wet due to the direct rainfall modelling method. In direct rainfall modelling, the threshold depth is generally accepted as 0.075m. This approach leads to some isolated areas of ponding. This is the same depth as the EA use in the NaFRA Risk of Flooding from Surface Water mapping.

Flood Extents

5.3. The maximum modelled flood extents for all modelled return periods are included in **Figure 19** and **Figure 20**.

Figure 19 – Abley Letchford Baseline Flood Extents



5.4. The model results show that there is flooding within the channel in the east of the site. There is also flooding to the south of the channel in the east of the channel. The ground levels in this area are below the bank levels of the Arborfield Cut therefore water flows along the ground in this area, rather than flowing into the Arborfield Cut.

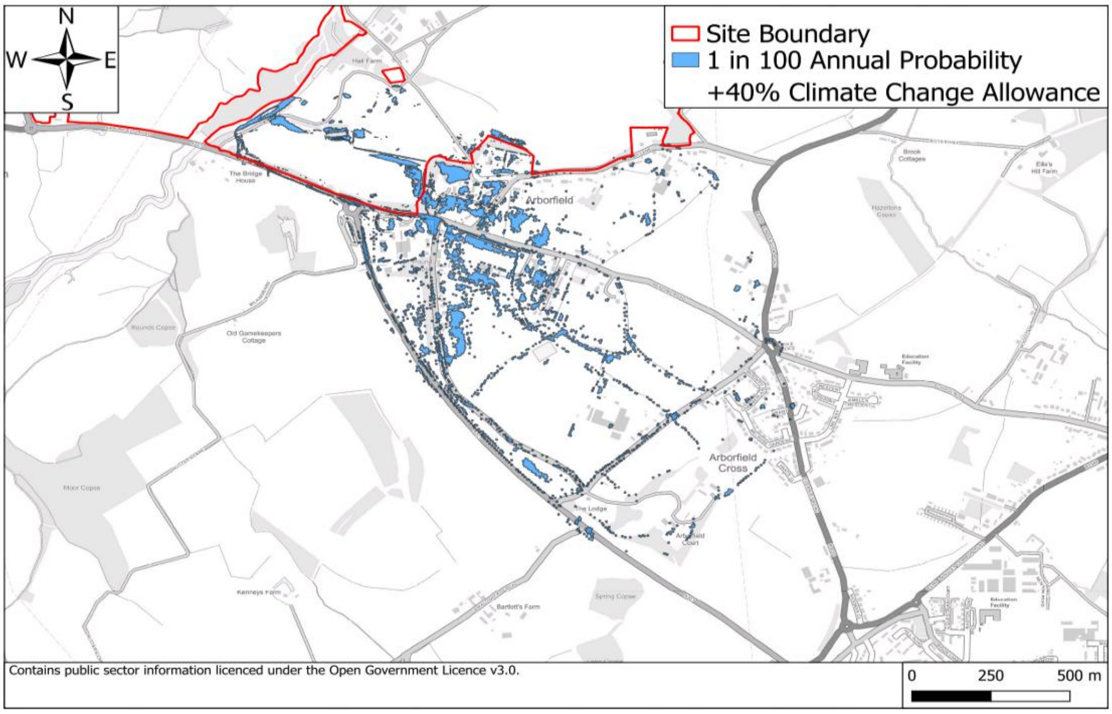
5.5. There is a notable area of ponding around the woodland in the centre of the site. There is a small tributary within the woodland, which is not modelled due to insufficient information, however the location of this flooding ties in with site observations of the low lying, flat ground within the woodland.

5.6. There is flooding upstream of the Dairy Research access road. The culvert under the road has a small diameter therefore water backs up in the low lying area to the east of the road.

5.7. The model results shows that there is flooding downstream of the Dairy Research access road. This is flooding from the downstream boundary flood level which was set from the River Loddon model therefore it is expected to be extensive as the River Loddon dominates flooding in this area.

5.8. There area number of areas of localise ponding within the site. These areas typically correspond with localised low points in the topography.

Figure 20 – Abley Letchford Climate Change Flood Extents



5.9. The 1 in 100 annual probability +40% climate change allowance scenario shows a similar pattern of flooding to the baseline model results. The flood mechanisms are the same.

Message Layers

5.10. No negative depth layers are present for all model runs. The model is therefore considered to be healthy and stable.

5.11. Model warning and check files were reviewed. All messaged were checked and are as expected.

5.12. Warnings and checks prior and during the simulation are saved within the TUFLOW '.tlf'. These messages were reviewed for each model run. The locations of the model warning and check files were reviewed, and they were considered to be insignificant.

TUFLOW Model Run Performance

5.13. The model is set up to run for the full range of events required. Table 4 provides a summary of the 2D domain performance parameters.

Table 4 – Model Run Parameters

Model Parameter	Value
Start time (hours)	0
End time (hours)	7.5
Model run time (hours)	8
Mass balance error	-3.15%

5.14. The mass balance error is greater than the 2% threshold which is typically considered to be acceptable for TUFLOW models. The error was investigated, and found that the higher error is at the beginning of the model run, as the downstream extent of the model is 'wetting' from the River Loddon downstream flood level.

5.15. All of the modelled simulations were run for the full 7.5 hours. The model runs were run beyond the peak of the event. Therefore, the maximum flood extents from the model are representative of the peaks for each modelled scenario.

Limitations and Assumptions

5.16. Key limitations and assumptions of the study are listed below:

- The FEH catchment descriptors are representative of the catchment.
- The LiDAR data is representative of the elevations across the catchment (for this study a sense check was undertaken but not a detailed review).
- The topographical survey of the elevations across the site are representative (for this study a sense check was undertaken but not a detailed review).
- The materials data is representative of the roughness of the catchment (for this study a sense check was undertaken but not a detailed review).
- A 1m grid size was used to represent the floodplain in the area of interest. A 5m grid was used to represent the floodplain outside of the area of interest. This grid size is considered to be appropriate for the rural location and proposed development. The grid size provides a reasonable balance between the model resolution and the model run time.
- As with all hydraulic modelling, there remains some residual uncertainty within the model results. However, we have tried to mitigate this through the sensitivity testing.

6.0 Conclusions

6.1. This modelling report has been prepared by Abley Letchford, on behalf of the University of Reading to refine the surface water extents for the Arborfield Cut, in Berkshire.

6.2. The model was run for the following return periods: 1 in 30, 1 in 100, and 1 in 1000 annual probability. The maximum flood levels and extents were extracted for all of the modelled return periods.

6.3. The site is located within the Loddon and Tributaries Management Catchment. The latest (July 2021) climate change allowances for the catchment is +40% for the Upper End allowance which is to be used to inform FRA studies. The maximum flood levels and extents were extracted for all the modelled climate change scenario.

6.4. A hydrological assessment was undertaken to provide hyetographs for the catchment. The FEH catchment descriptors were reviewed and refined using a desk-based assessment. ReFH2 software was used for the hydrological assessment.

6.5. Sensitivity testing was carried out to determine the impact of uncertainty and assumptions made within the modelling. Sensitivity tests were carried out for Manning's 'n' roughness values, culvert blockage and culvert diameter. Sensitivity testing results showed that the model was not sensitive to the key assumptions made within the modelling; ±20% increase or decrease in the Manning's 'n' roughness values, culvert blockages or culvert diameter.

Appendices

Appendix A - Hydrological Report

HALL FARM, LODDON GARDEN VILLAGE SDL

HYDROLOGICAL ASSESSMENT: ARBORFIELD CUT

UNIVERSITY OF READING

20 JUNE 2025

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Contents

Appendices

1.0 Summary of Assessment

Summary

1.1. This Flood Estimation Report has been prepared by Abley Letchford on behalf of the University of Reading to provide hyetographs for a direct rainfall model of the Arborfield Cut catchment in Berkshire using the latest data, software and methods proportionate to the scope of work.

1.2. The study is considered to be routine based on the Environment Agency (EA) Flood Estimation Guidance competency framework.

1.3. The catchment is predominantly rural. There are a number of urban areas within the catchment, most notably the villages of Arborfield and Arborfield Cross.

1.4. The catchment is not influenced by reservoirs. The catchment does not have extensive floodplain storage.

1.5. The catchment is not groundwater driven. They key mechanism of flooding is therefore flood flows exceeding the channel capacity and overland surface water flow.

1.6. The catchment is ungauged and therefore a limitation of the study is the lack of locally available information.

1.7. The ReFH2 method was completed.

Flood Frequencies

1.8. The frequency of a flood event can be expressed in either annual exceedance probability (AEP) or as a return period. A return periods is defined as the average time between years with a larger flood event. An AEP is defined as the probability of a certain size event being exceeded over a given period.

1.9. **Table 1** provides a conversion between return periods and AEP.

Table 1 - Annual Exceedance Probability (AEP) and Related Return Period

Annual Exceedance Probability (%)	50	20	10	5	3.33	2	1.33	1	0.5	0.1
Annual Exceedance Probability	0.5	0.2	0.1	0.05	0.033	0.02	0.0133	0.01	0.005	0.001
Return Period (years)	2	5	10	20	30	50	75	100	200	1,000

2.0 Method

Requirement for Flood Estimates

Overview

2.1. This study provides hyetographs for a direct rainfall model with defined channels for Arborfield Cut west of Arborfield in Berkshire. The latest data, methodologies and software have been used, proportionate to the scope of works.

2.2. The study derives hyetographs estimates for the catchment. The hyetographs will be applied to the direct rainfall model using 2d_rf polygons, which will apply uniform rainfall across the catchment.

2.3. As part of the study, hyetographs will be calculated for the following return periods:

- 1 in 2
- 1 in 5
- 1 in 10
- 1 in 20
- 1 in 30
- 1 in 50
- 1 in 75
- 1 in 100
- 1 in 200
- 1 in 1000

2.4. Climate change will be considered for the 1 in 100 annual probability scenario. This will be discussed separately.

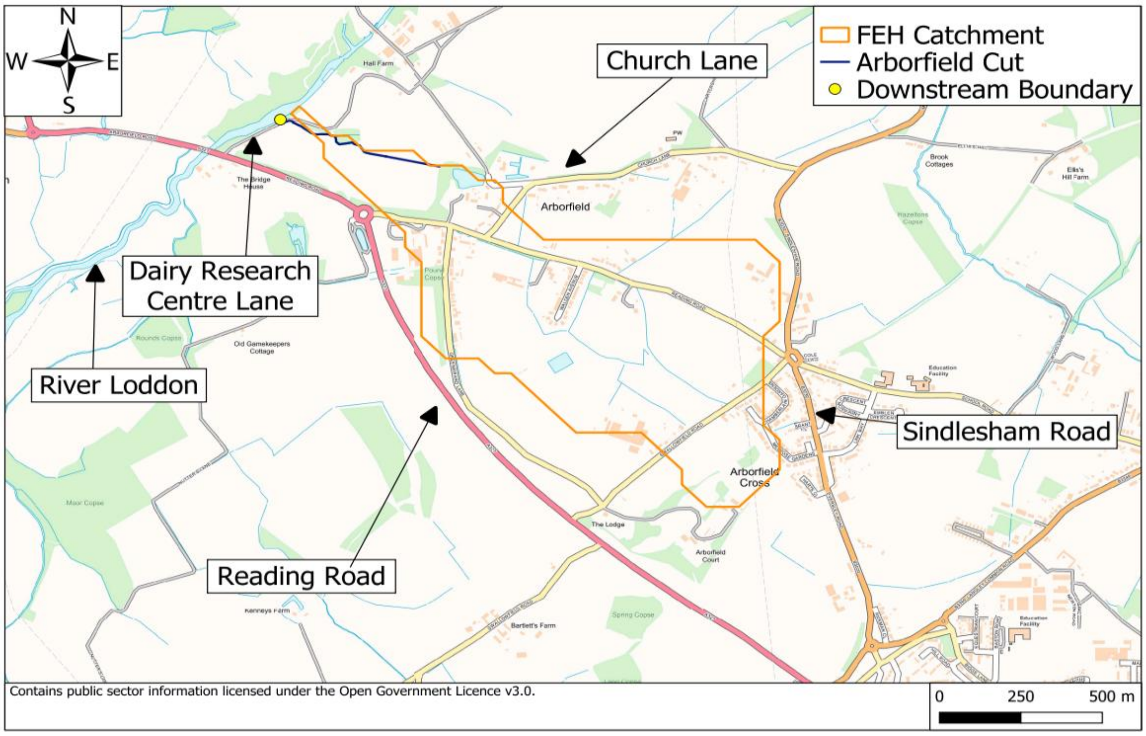
Project Scope

2.5. This study is considered to be routine based on the EA Flood Estimation Guidance competency framework.

Catchment

2.6. The catchment area was downloaded from the FEH Web Service as part of the catchment descriptors. The catchment area, site location and key features are shown in **Figure 1**.

Figure 1 – Catchment Overview



2.7. The FEH catchment area is 0.8km^2.

2.8. The area of interest is in the eastern part of the catchment, as shown in **Figure 1**.

2.9. There are suburban areas in the eastern and central parts of the catchment. The western part of the catchment is predominantly rural.

Gauging Stations

2.10. There are no available gauging stations within the catchment.

Other Data Sources

2.11. **Table 2** summarises other sources of data used within the study

Table 2 – Summary of Other Sources of Data

Data	Relevance	Availability	Source	Details
Check flow gauging	Yes	No	NA	NA
Historic flood data	Yes	Yes	DEFRA	Historic flood extent GIS records
Flow or river level data for events	Yes	No	NA	NA
Rainfall data for events	Yes	No	NA	NA
Potential evaporation data	Yes	No	NA	NA
Results from previous studies	Yes	Yes	EA Lower Loddon Flood Study	EA Lower Loddon Flood Study: TH648,

			JBA Arborfield Cut modelling study	dated December 2006 JBA Arborfield Cut modelling study dated 2023.

EA Lower Loddon Study

2.12. As discussed in **Table 2**, the Arborfield Cut was included within the EA Lower Loddon Study dated 2007. This model and hydrology study has been replaced by the EA River Loddon 2009 model as the EA approved model. The EA River Loddon model does not include the Arborfield Cut model. The EA 2007 hydrology is 19 years old. Software and methods have progressed since the 2007 hydrology was completed therefore the Abley Letchford hydrology has been used in preference to the EA study.

JBA Arborfield Cut Study

2.13. As discussed in **Table 2**, JBA completed a hydrology and modelling study of the Arborfield Cut in 2023. This used more up to date software and methods compared with the EA 2007 study. Abley Letchford reviewed the JBA catchment against Ordnance Survey mapping, LiDAR data and site observations. Whilst the Abley Letchford catchment largely agreed with the JBA catchment boundary, Abley Letchford disagree with the JBA catchment boundary to the south of Arborfield Road and believe that it is overestimating the catchment area in this location.

2.14. Abley Letchford have therefore completed a separate hydrological assessment to derive hyetographs for the Arborfield Catchment.

Hydrological Understanding of the Catchment

Conceptual Model

2.15. The site location and catchment area are shown in **Figure 1**. The likely cause of flooding at the site is flow exceeding the channel capacity and surface water flow.

Unusual Catchment features

2.16. The villages of Arborfield and Arborfield Cross are located within the catchment. The catchment is not considered to be heavily urbanised.

2.17. There are no reservoirs within the catchment.

2.18. The catchment is not pumped.

2.19. The catchment is not highly permeable.

2.20. The catchment has not been previously mined.

Initial Choice of Approach

Is FEH Appropriate

2.21. FEH methods are considered to be appropriate, as the UK regulatory recommended methods for estimation river flood frequency and design rainfall in England.

2.22. The ReFH2 (version 2.3) methods will be carried out.

2.23. The catchment will be lumped.

Software

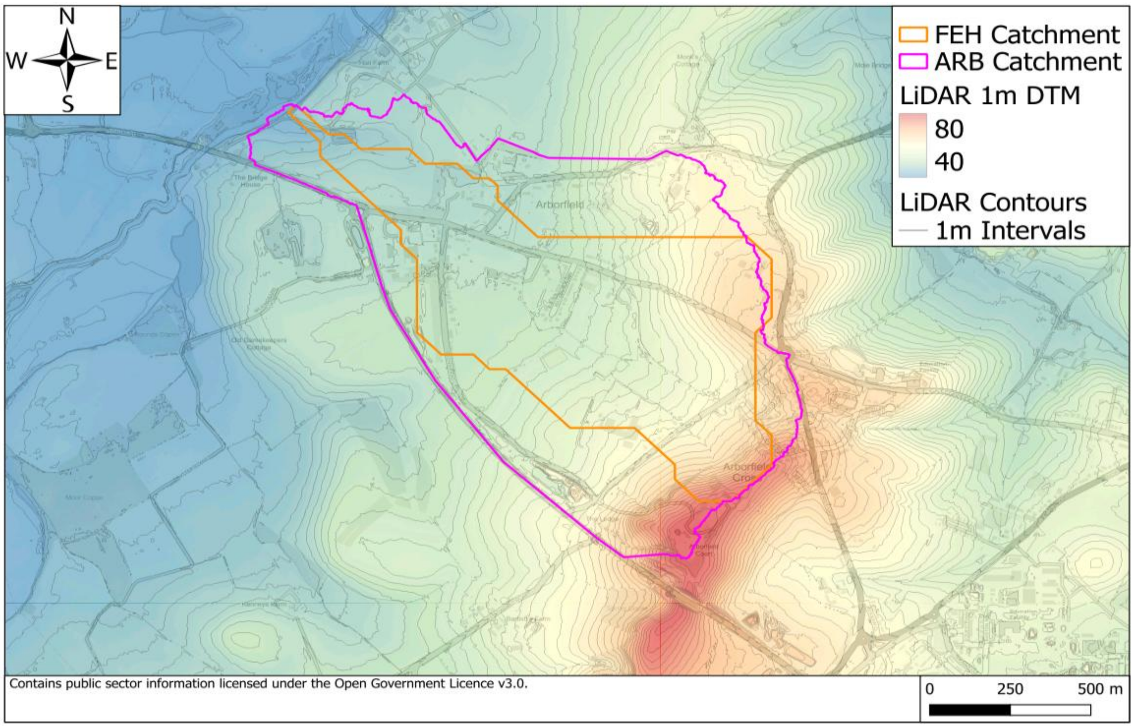
2.24. The following software was used in this study:

- FEH Web Service; and
- ReFH2.3.

3.0 Flood Estimates

3.1. **Figure 2** shows the located of the FEH catchment, adjusted catchment (ARB) and site location.

Figure 2 – Comparison of the FEH Catchment and Adjusted Catchment Areas



Imported Catchment Descriptors

3.2. The catchment descriptors were extracted from the FEH Web Service.

3.3. The red text in **Table 3** has been used to identify the catchment descriptors that have been updated from the FEH downloaded values.

Table 3 – Summary of the Updated FEH Catchment Descriptors

Site Code	FARL	PROWET	BFIHOST	BFIHOST19	DLPBAR (km)	DPSBAR (m/km)	SAAR (mm)	URBEXT1990	URBXT2000	FPEXT
ARB	0.99	0.29	0.357	0.407	1.22	19.4	648	0.12	0.12	0.12

Checking Catchment Descriptors

Catchment Boundary

3.4. The FEH Online Service catchment boundary was checked using LiDAR data, EA indicative watershed dataset and Ordnance Survey data. A site walkover was also completed which checked assumptions made on the catchment boundary.

3.5. The catchment boundary was adjusted to consider the slope of the catchment and the road drainage network.

3.6. The catchment area increased from 0.8 km^2 to 1.4 km^2, an increase of 0.6 km^2.

BFIHOST and SPRHOST

3.7. BFIHOST, BFIHOST19 and SPRHOST values for the catchment were checked using the Soilscapes online viewer.

3.8. The descriptor values were reviewed and deemed to be representative of the catchment soil type.

FARL

3.9. The FARL value was checked against OS mapping and the FEH Web Service information on reservoir and lake storage areas.

3.10. The FARL value is considered to be appropriate.

URBEXT

3.11. The urban extents on the FEH Web Service were compared with OS urban extents, satellite imagery and site observations. The FEH URBEXT values did not represent the urban areas within the catchment. The villages of Arborfield and Arborfield Cross are located in central and eastern parts of the catchment respectively.

3.12. FEH Volume 5 Equation 6.2 was used to calculate the URBEXT value. Equation 4.5 in 'URBEXT2000- a new catchment descriptor' was used to calculate the URBEXT2000 value.

4.0 Revitalised Flood Hydrograph 2 (ReFH2)

Application of the ReFH2 Method

4.1. The purpose of carrying out the ReFH2 method is to estimate hyetographs for the catchment.

Catchment Sub-Divisions in the ReFH2 Model

4.2. The catchment was not further subdivided. The rural results were extracted.

Parameters for ReFH2 Model

4.3. **Table 4** provides a summary of the ReFH2 parameters.

Table 4 – Summary of ReFH2 Parameters

Site code	Method	Tprural (hours)	Tpurban (hours)	Cmax (mm) Maximum storage capacity	PRimp	BL (hours) Baseflow lag	BR Baseflow recharge
ARB_002	CD	4.42	-	453.1	0.7	38.91	2.34
OPT: Optimisation, BR: Baseflow recession fitting, CD: Catchment descriptors, DT: Data transfer							

Flood Estimates from the ReFH2 Method

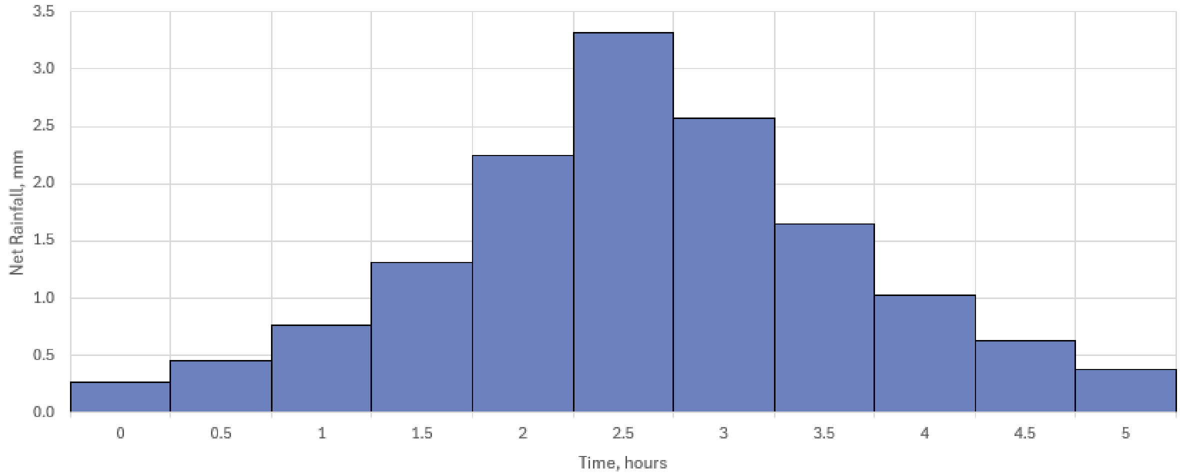
4.4. **Table 5** provides a summary of the ReFH2 method peak net rainfall values.

Table 5 – Summary of ReFH2 Method Peak Net Rainfall

Site code	Peak net rainfall (mm) for the following return periods (in years)									
	2	5	10	20	30	50	75	100	200	1000
ARB_002	1.3	1.9	2.3	2.7	2.9	3.2	3.5	3.7	4.4	6.7

4.5. **Figure 3** shows the 1 in 100 annual probability hyetograph.

Figure 3 – 1 in 100 Annual Probability Hyetograph



5.0 Discussion and Summary of Results

Assumptions, Limitations and Uncertainty

Assumptions

5.1. The following assumptions were made in this study:

- The catchment descriptors are representative of the catchment;
- The catchment areas are representative of the areas being drained;
- The QMED values calculated are representative; and
- The ReFH2 hydrograph shapes are representative of the catchment response.

Limitations

5.2. A limitation of this study is that gauge data is not available.

Uncertainty

5.3. Uncertainty is not currently assessed within ReFH2, the final method selected.

Suitability for Future Studies

5.4. The hyetographs calculated as part of this study are specific to the model extent. If future studies are located within the model extent, the results should be reviewed at a minimum. If future studies are located outside of the model boundary, an update to the hydrology may be required.

Checks

5.5. **Table 6** provides a summary of the checks carried out.

Table 6 – Summary of Checks

Are the results consistent, for example at confluences?	The results have consistent hyetographs, looking at the proportionate areas.
What do the results imply regarding the return periods of floods during the period of record?	NA – no gauge data of historic flood records available for comparison.
What is the 100-year growth factor? Is this realistic? (The guidance suggests a typical range of 2.1 to 4.0)	2.8 - This is within the typical range.
If 1000-year flows have been derived, what is the range of ratios for 1000-year flow over 100-year flow?	1.79
How do the results compare with those of other studies? Explain any differences and conclude which results should be preferred.	The EA Lower Loddon Flood Study, dated 2006 includes the Arborfield Cut as a sub catchment. The study has been discounted due to being 19 years old. Methods and software have progressed since the study was completed. JBA completed a study of the Arborfield Cut in 2023. This used more up to date software and methods compared with the EA 2007 study. Abley Letchford reviewed the JBA catchment against Ordnance Survey mapping, LiDAR data and site observations. Whilst the Abley

	Letchford catchment largely agreed with the JBA catchment boundary, Abley Letchford disagree with the JBA catchment boundary to the south of Arborfield Road and believe that it is overestimating the catchment area in this location. Abley Letchford have therefore completed a separate hydrological assessment to derive hyetographs for the Arborfield Catchment.
Are the results compatible with the longer-term flood history?	Data from historic flood was not available at this site.
Describe any other checks on the results	NA

Final Results

5.6. The final accepted peak net rainfall for this study are summarised in **Table 7**.

Table 7 – Summary of the Final Accepted Peak Net Rainfall

Site code	Peak net rainfall (mm) for the following return periods (in years)									
	2	5	10	20	30	50	75	100	200	1000
ARB_002	1.33	1.88	2.26	2.65	2.89	3.22	3.51	3.73	4.38	6.66

Appendices

Appendix 1 - ReFH2 Summary

UK Design Flood Estimation

Generated on 07 May 2025 15:01:16 by Hydro2
Printed from the ReFH2 Flood Modelling software package, version 4.1.8879.22310

Summary of estimate using the Flood Estimation Handbook revitalised flood hydrograph method (ReFH2)

Site details Checksum: 5AD4-59F5

Site name: ARB_002

Easting: 474650

Northing: 167900

Country: England, Wales or Northern Ireland

Catchment Area (km²): 1.44

Using plot scale calculations: No

Model: 2.3

Site description: None

Model run: 100 year

Summary of results

Rainfall - FEH22 (mm):	67.33	Total runoff (ML):	23.25
Total Rainfall (mm):	44.32	Total flow (ML):	63.79
Peak Rainfall (mm):	10.07	Peak flow (m³/s):	1.17

Parameters

Where the user has overriden a system-generated value, this original value is shown in square brackets after the value used.
** Indicates that the user locked the duration/timestep*

Rainfall parameters (Rainfall - FEH22)

Name	Value	User-defined?
Duration (hh:mm:ss)	05:30:00	No
Timestep (hh:mm:ss)	00:30:00	No
SCF (Seasonal correction factor)	0.67	No
ARF (Areal reduction factor)	0.98	No
Seasonality	Winter	No

Loss model parameters

Name	Value	User-defined?
Cini (mm)	106.75	No
Cmax (mm)	391.75	No
Use alpha correction factor	No	No
Alpha correction factor	n/a	No

Routing model parameters

Name	Value	User-defined?
Tp (hr)	3.43	No
Up	0.65	No
Uk	0.8	No

Baseflow model parameters

Name	Value	User-defined?
BF0 (m^3/s)	0.04	No
BL (hr)	36.11	No
BR	2.04	No

Urbanisation parameters

Name	Value	User-defined?
Sewer capacity (m^3/s)	0	No
Exporting drained area (km^2)	0	No
Urban area (km^2)	0.27	No
Effective URBEXT2000	0.12	n/a
Impervious runoff factor	0.7	No
Imperviousness factor	0.4	No
Tp scaling factor	0.75	No
Depression storage depth (mm)	0.5	No

Time series data

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (m^3/s)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
00:00:00	0.973	0.000	0.300	0.000	0.036	0.036
00:30:00	1.630	0.000	0.514	0.002	0.035	0.037
01:00:00	2.717	0.000	0.870	0.010	0.035	0.045
01:30:00	4.493	0.000	1.478	0.026	0.035	0.061
02:00:00	7.311	0.000	2.510	0.059	0.035	0.094
02:30:00	10.071	0.000	3.670	0.118	0.036	0.155
03:00:00	7.311	0.000	2.818	0.218	0.039	0.257
03:30:00	4.493	0.000	1.796	0.358	0.044	0.402
04:00:00	2.717	0.000	1.110	0.520	0.052	0.572
04:30:00	1.630	0.000	0.674	0.686	0.064	0.750
05:00:00	0.973	0.000	0.406	0.839	0.079	0.917
05:30:00	0.000	0.000	0.000	0.958	0.097	1.055
06:00:00	0.000	0.000	0.000	1.026	0.117	1.144
06:30:00	0.000	0.000	0.000	1.035	0.139	1.174
07:00:00	0.000	0.000	0.000	0.992	0.161	1.153
07:30:00	0.000	0.000	0.000	0.917	0.182	1.099
08:00:00	0.000	0.000	0.000	0.826	0.201	1.027
08:30:00	0.000	0.000	0.000	0.730	0.217	0.947
09:00:00	0.000	0.000	0.000	0.635	0.232	0.866
09:30:00	0.000	0.000	0.000	0.546	0.244	0.790
10:00:00	0.000	0.000	0.000	0.469	0.253	0.722
10:30:00	0.000	0.000	0.000	0.401	0.262	0.663
11:00:00	0.000	0.000	0.000	0.341	0.268	0.609
11:30:00	0.000	0.000	0.000	0.286	0.273	0.559
12:00:00	0.000	0.000	0.000	0.237	0.277	0.514
12:30:00	0.000	0.000	0.000	0.193	0.280	0.473
13:00:00	0.000	0.000	0.000	0.155	0.282	0.436
13:30:00	0.000	0.000	0.000	0.119	0.282	0.401
14:00:00	0.000	0.000	0.000	0.087	0.282	0.368
14:30:00	0.000	0.000	0.000	0.058	0.280	0.338
15:00:00	0.000	0.000	0.000	0.035	0.278	0.313
15:30:00	0.000	0.000	0.000	0.019	0.275	0.294
16:00:00	0.000	0.000	0.000	0.010	0.271	0.281
16:30:00	0.000	0.000	0.000	0.004	0.268	0.272

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (m^3/s)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
17:00:00	0.000	0.000	0.000	0.001	0.264	0.266
17:30:00	0.000	0.000	0.000	0.000	0.261	0.261
18:00:00	0.000	0.000	0.000	0.000	0.257	0.257
18:30:00	0.000	0.000	0.000	0.000	0.254	0.254
19:00:00	0.000	0.000	0.000	0.000	0.250	0.250
19:30:00	0.000	0.000	0.000	0.000	0.247	0.247
20:00:00	0.000	0.000	0.000	0.000	0.243	0.243
20:30:00	0.000	0.000	0.000	0.000	0.240	0.240
21:00:00	0.000	0.000	0.000	0.000	0.237	0.237
21:30:00	0.000	0.000	0.000	0.000	0.233	0.233
22:00:00	0.000	0.000	0.000	0.000	0.230	0.230
22:30:00	0.000	0.000	0.000	0.000	0.227	0.227
23:00:00	0.000	0.000	0.000	0.000	0.224	0.224
23:30:00	0.000	0.000	0.000	0.000	0.221	0.221
24:00:00	0.000	0.000	0.000	0.000	0.218	0.218
24:30:00	0.000	0.000	0.000	0.000	0.215	0.215
25:00:00	0.000	0.000	0.000	0.000	0.212	0.212
25:30:00	0.000	0.000	0.000	0.000	0.209	0.209
26:00:00	0.000	0.000	0.000	0.000	0.206	0.206
26:30:00	0.000	0.000	0.000	0.000	0.203	0.203
27:00:00	0.000	0.000	0.000	0.000	0.200	0.200
27:30:00	0.000	0.000	0.000	0.000	0.198	0.198
28:00:00	0.000	0.000	0.000	0.000	0.195	0.195
28:30:00	0.000	0.000	0.000	0.000	0.192	0.192
29:00:00	0.000	0.000	0.000	0.000	0.190	0.190
29:30:00	0.000	0.000	0.000	0.000	0.187	0.187
30:00:00	0.000	0.000	0.000	0.000	0.184	0.184
30:30:00	0.000	0.000	0.000	0.000	0.182	0.182
31:00:00	0.000	0.000	0.000	0.000	0.179	0.179
31:30:00	0.000	0.000	0.000	0.000	0.177	0.177
32:00:00	0.000	0.000	0.000	0.000	0.175	0.175
32:30:00	0.000	0.000	0.000	0.000	0.172	0.172
33:00:00	0.000	0.000	0.000	0.000	0.170	0.170
33:30:00	0.000	0.000	0.000	0.000	0.167	0.167
34:00:00	0.000	0.000	0.000	0.000	0.165	0.165

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (m^3/s)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
34:30:00	0.000	0.000	0.000	0.000	0.163	0.163
35:00:00	0.000	0.000	0.000	0.000	0.161	0.161
35:30:00	0.000	0.000	0.000	0.000	0.158	0.158
36:00:00	0.000	0.000	0.000	0.000	0.156	0.156
36:30:00	0.000	0.000	0.000	0.000	0.154	0.154
37:00:00	0.000	0.000	0.000	0.000	0.152	0.152
37:30:00	0.000	0.000	0.000	0.000	0.150	0.150
38:00:00	0.000	0.000	0.000	0.000	0.148	0.148
38:30:00	0.000	0.000	0.000	0.000	0.146	0.146
39:00:00	0.000	0.000	0.000	0.000	0.144	0.144
39:30:00	0.000	0.000	0.000	0.000	0.142	0.142
40:00:00	0.000	0.000	0.000	0.000	0.140	0.140
40:30:00	0.000	0.000	0.000	0.000	0.138	0.138
41:00:00	0.000	0.000	0.000	0.000	0.136	0.136
41:30:00	0.000	0.000	0.000	0.000	0.134	0.134
42:00:00	0.000	0.000	0.000	0.000	0.132	0.132
42:30:00	0.000	0.000	0.000	0.000	0.130	0.130
43:00:00	0.000	0.000	0.000	0.000	0.129	0.129
43:30:00	0.000	0.000	0.000	0.000	0.127	0.127
44:00:00	0.000	0.000	0.000	0.000	0.125	0.125
44:30:00	0.000	0.000	0.000	0.000	0.123	0.123
45:00:00	0.000	0.000	0.000	0.000	0.122	0.122
45:30:00	0.000	0.000	0.000	0.000	0.120	0.120
46:00:00	0.000	0.000	0.000	0.000	0.118	0.118
46:30:00	0.000	0.000	0.000	0.000	0.117	0.117
47:00:00	0.000	0.000	0.000	0.000	0.115	0.115
47:30:00	0.000	0.000	0.000	0.000	0.114	0.114
48:00:00	0.000	0.000	0.000	0.000	0.112	0.112
48:30:00	0.000	0.000	0.000	0.000	0.111	0.111
49:00:00	0.000	0.000	0.000	0.000	0.109	0.109
49:30:00	0.000	0.000	0.000	0.000	0.108	0.108
50:00:00	0.000	0.000	0.000	0.000	0.106	0.106
50:30:00	0.000	0.000	0.000	0.000	0.105	0.105
51:00:00	0.000	0.000	0.000	0.000	0.103	0.103
51:30:00	0.000	0.000	0.000	0.000	0.102	0.102

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (m^3/s)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
52:00:00	0.000	0.000	0.000	0.000	0.100	0.100
52:30:00	0.000	0.000	0.000	0.000	0.099	0.099
53:00:00	0.000	0.000	0.000	0.000	0.098	0.098
53:30:00	0.000	0.000	0.000	0.000	0.096	0.096
54:00:00	0.000	0.000	0.000	0.000	0.095	0.095
54:30:00	0.000	0.000	0.000	0.000	0.094	0.094
55:00:00	0.000	0.000	0.000	0.000	0.092	0.092
55:30:00	0.000	0.000	0.000	0.000	0.091	0.091
56:00:00	0.000	0.000	0.000	0.000	0.090	0.090
56:30:00	0.000	0.000	0.000	0.000	0.089	0.089
57:00:00	0.000	0.000	0.000	0.000	0.087	0.087
57:30:00	0.000	0.000	0.000	0.000	0.086	0.086
58:00:00	0.000	0.000	0.000	0.000	0.085	0.085
58:30:00	0.000	0.000	0.000	0.000	0.084	0.084
59:00:00	0.000	0.000	0.000	0.000	0.083	0.083
59:30:00	0.000	0.000	0.000	0.000	0.082	0.082
60:00:00	0.000	0.000	0.000	0.000	0.080	0.080
60:30:00	0.000	0.000	0.000	0.000	0.079	0.079
61:00:00	0.000	0.000	0.000	0.000	0.078	0.078
61:30:00	0.000	0.000	0.000	0.000	0.077	0.077
62:00:00	0.000	0.000	0.000	0.000	0.076	0.076
62:30:00	0.000	0.000	0.000	0.000	0.075	0.075
63:00:00	0.000	0.000	0.000	0.000	0.074	0.074
63:30:00	0.000	0.000	0.000	0.000	0.073	0.073
64:00:00	0.000	0.000	0.000	0.000	0.072	0.072
64:30:00	0.000	0.000	0.000	0.000	0.071	0.071
65:00:00	0.000	0.000	0.000	0.000	0.070	0.070
65:30:00	0.000	0.000	0.000	0.000	0.069	0.069
66:00:00	0.000	0.000	0.000	0.000	0.068	0.068
66:30:00	0.000	0.000	0.000	0.000	0.067	0.067
67:00:00	0.000	0.000	0.000	0.000	0.066	0.066
67:30:00	0.000	0.000	0.000	0.000	0.065	0.065
68:00:00	0.000	0.000	0.000	0.000	0.064	0.064
68:30:00	0.000	0.000	0.000	0.000	0.064	0.064
69:00:00	0.000	0.000	0.000	0.000	0.063	0.063

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (m^3/s)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
69:30:00	0.000	0.000	0.000	0.000	0.062	0.062
70:00:00	0.000	0.000	0.000	0.000	0.061	0.061
70:30:00	0.000	0.000	0.000	0.000	0.060	0.060
71:00:00	0.000	0.000	0.000	0.000	0.059	0.059
71:30:00	0.000	0.000	0.000	0.000	0.058	0.058
72:00:00	0.000	0.000	0.000	0.000	0.058	0.058
72:30:00	0.000	0.000	0.000	0.000	0.057	0.057
73:00:00	0.000	0.000	0.000	0.000	0.056	0.056
73:30:00	0.000	0.000	0.000	0.000	0.055	0.055
74:00:00	0.000	0.000	0.000	0.000	0.055	0.055
74:30:00	0.000	0.000	0.000	0.000	0.054	0.054
75:00:00	0.000	0.000	0.000	0.000	0.053	0.053
75:30:00	0.000	0.000	0.000	0.000	0.052	0.052
76:00:00	0.000	0.000	0.000	0.000	0.052	0.052
76:30:00	0.000	0.000	0.000	0.000	0.051	0.051
77:00:00	0.000	0.000	0.000	0.000	0.050	0.050
77:30:00	0.000	0.000	0.000	0.000	0.050	0.050
78:00:00	0.000	0.000	0.000	0.000	0.049	0.049
78:30:00	0.000	0.000	0.000	0.000	0.048	0.048
79:00:00	0.000	0.000	0.000	0.000	0.047	0.047
79:30:00	0.000	0.000	0.000	0.000	0.047	0.047
80:00:00	0.000	0.000	0.000	0.000	0.046	0.046
80:30:00	0.000	0.000	0.000	0.000	0.046	0.046
81:00:00	0.000	0.000	0.000	0.000	0.045	0.045
81:30:00	0.000	0.000	0.000	0.000	0.044	0.044
82:00:00	0.000	0.000	0.000	0.000	0.044	0.044
82:30:00	0.000	0.000	0.000	0.000	0.043	0.043
83:00:00	0.000	0.000	0.000	0.000	0.043	0.043
83:30:00	0.000	0.000	0.000	0.000	0.042	0.042
84:00:00	0.000	0.000	0.000	0.000	0.041	0.041
84:30:00	0.000	0.000	0.000	0.000	0.041	0.041
85:00:00	0.000	0.000	0.000	0.000	0.040	0.040
85:30:00	0.000	0.000	0.000	0.000	0.040	0.040
86:00:00	0.000	0.000	0.000	0.000	0.039	0.039
86:30:00	0.000	0.000	0.000	0.000	0.039	0.039

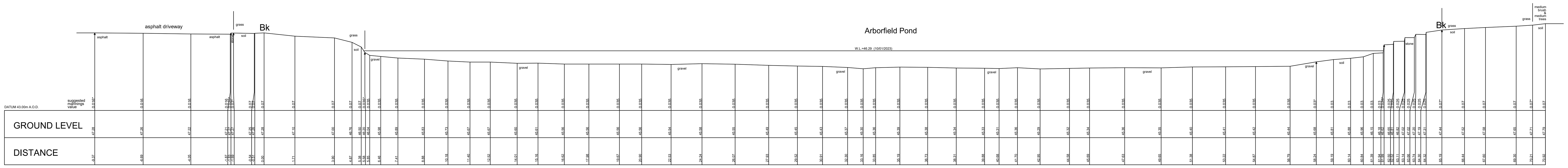
Time (hh:mm:ss)	Rain (mm)	Sewer Loss (m^3/s)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
87:00:00	0.000	0.000	0.000	0.000	0.038	0.038
87:30:00	0.000	0.000	0.000	0.000	0.038	0.038
88:00:00	0.000	0.000	0.000	0.000	0.037	0.037
88:30:00	0.000	0.000	0.000	0.000	0.037	0.037

Appendix

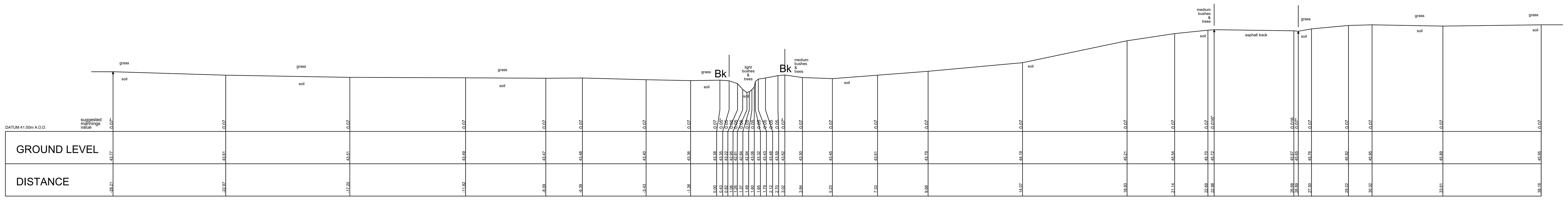
Catchment descriptors

Name	Value	User-defined value used?
Area (km^2)	1.44	No
ALTBAR	55	No
ASPBAR	307	No
ASPVAR	0.79	No
BFIHOST	0.52	No
BFIHOST19	0.47	No
DPLBAR (km)	1.22	No
DPSBAR (mkm^{-1})	19.4	No
FARL	0.99	No
LDP	2.12	No
PROPWET	0.29	No
RMED1H	11.5	No
RMED1D	28.9	No
RMED2D	36.6	No
SAAR (mm)	648	No
SAAR4170 (mm)	649	No
SPRHOST	42.34	No
URBEXT2000	0.12	No
URBEXT1990	0.12	No
URBCONC	0.56	No
URBLOC	1.03	No
DDF parameter C	-0.03	No
DDF parameter D1	0.27	No
DDF parameter D2	0.27	No
DDF parameter D3	0.32	No
DDF parameter E	0.3	No
DDF parameter F	2.63	No
DDF parameter C (1km grid value)	-0.03	No
DDF parameter D1 (1km grid value)	0.26	No
DDF parameter D2 (1km grid value)	0.26	No
DDF parameter D3 (1km grid value)	0.33	No
DDF parameter E (1km grid value)	0.3	No
DDF parameter F (1km grid value)	2.62	No

Appendix B - Topographical Survey

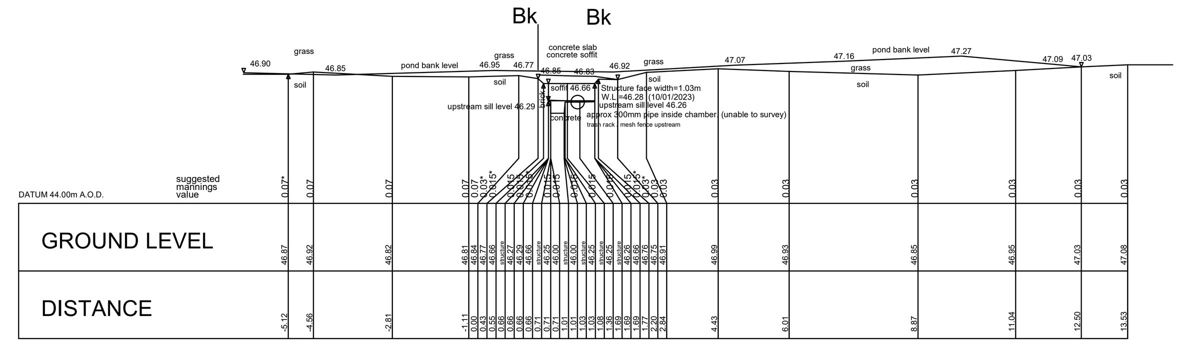


Arborfield pond channel CS LO3101.0660
Centre OSNG Coordinates E.475170.90 N.167681.03



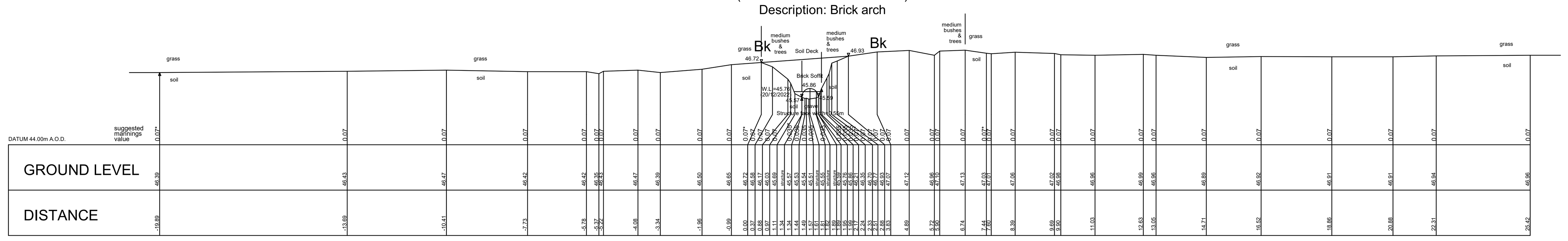
Arborfield pond channel CS LO31.0175
Centre OSNG Coordinates E.474746.49 N.167827.44

Structure no. 3. Arborfield Pond Outfall
(upstream face of structure)
Description: Conc culvert with internal @300mm pipe

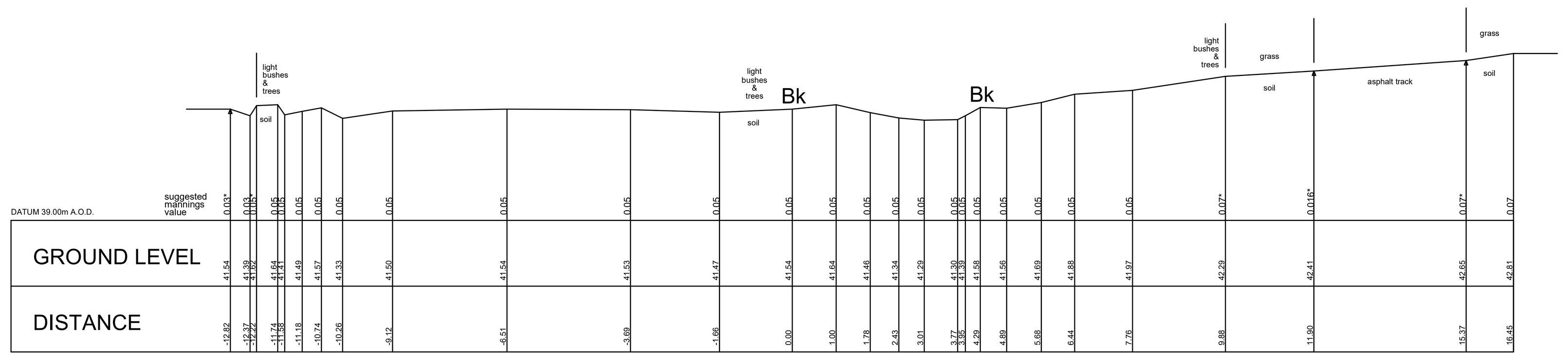


Arborfield pond channel CS LO3101.0615
Centre OSNG Coordinates E.475126.86 N.167688.03

Structure no. 3. Arborfield pond culvert
(downstream face of structure)
Description: Brick arch

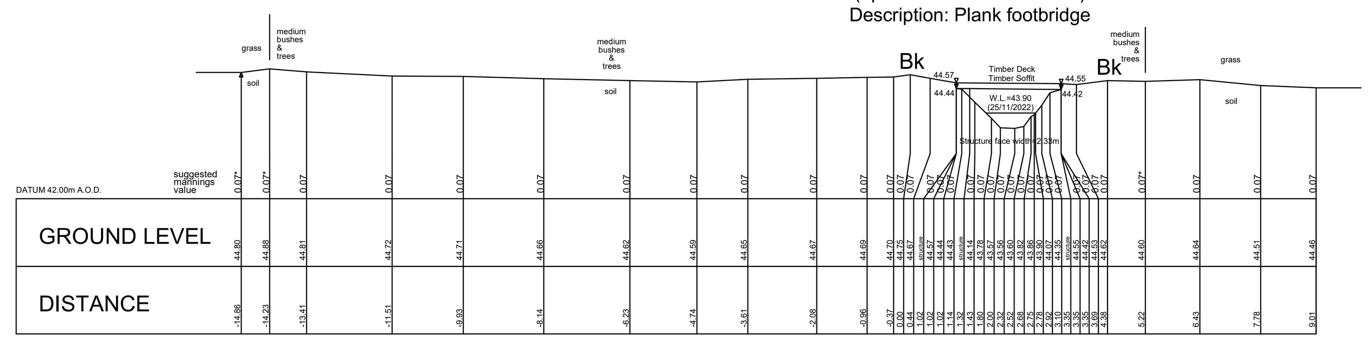


Arborfield pond channel CS LO31.0553
Centre OSNG Coordinates E.475079.26 N.167722.52



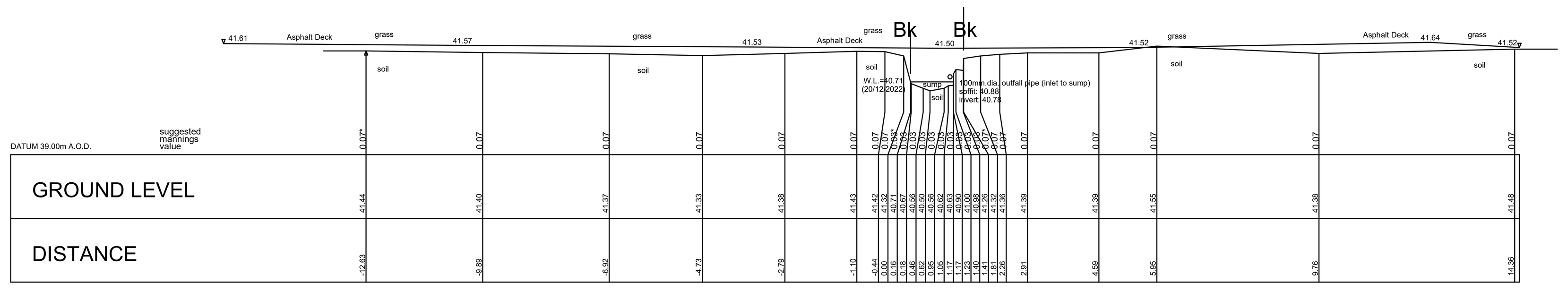
Arborfield pond channel CS LO31.0052
Centre OSNG Coordinates E.474631.62 N.167869.42

Structure no. 2. Plank footbridge
(upstream face of structure)
Description: Plank footbridge



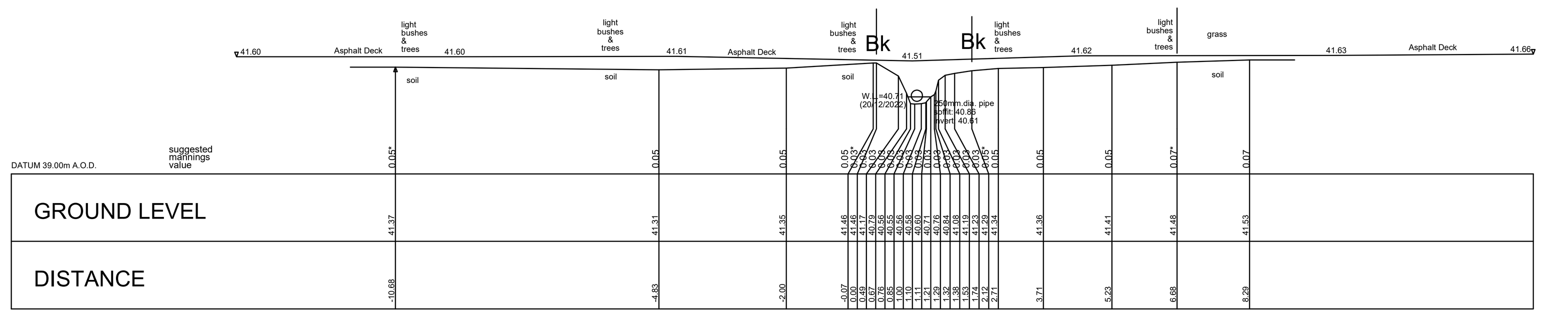
Arborfield pond channel CS LO31.0303
Centre OSNG Coordinates E.474839.79 N.167781.30

Structure no. 1. Access track culvert
(upstream face of structure)
Description: No culvert pipe found. (Buried?)
Structure Length = 9.00m



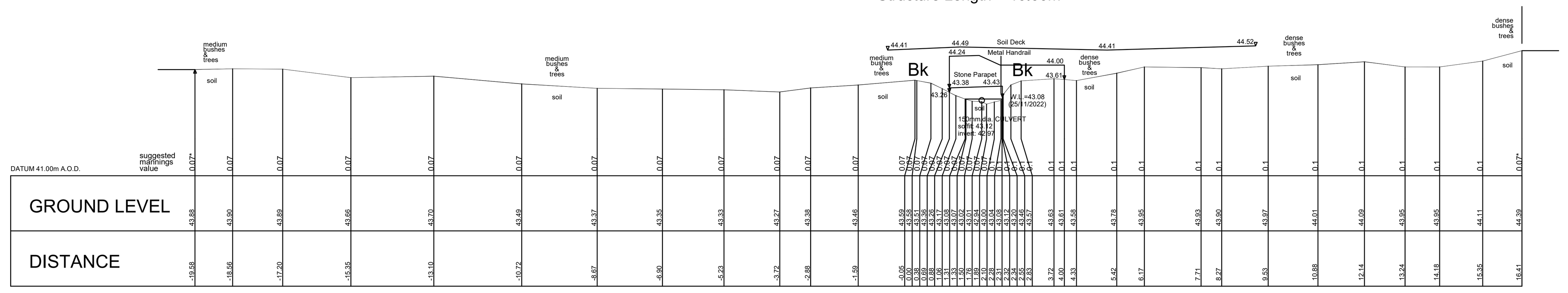
Arborfield pond channel CS LO31.0017
Centre OSNG Coordinates E.474600.39 N.167869.38

Structure no. 1. Access track culvert
(downstream face of structure)
Description: 250mm Pipe
Structure Length = 9.00m



Arborfield pond channel CS LO31.0009
Centre OSNG Coordinates E.474595.47 N.167875.78

Structure no. 1. Tributary culvert
(downstream face of structure)
Description: 150mm Pipe
Structure Length = 10.00m



Arborfield pond channel tributary CS LO32.0077
Centre OSNG Coordinates E.474833.34 N.167826.48

LEGEND FOR SURFACE & VEGETATION CHANGES:
ABOVE GROUND VEGETATION & SEPARATOR
GROUND SURFACE & SEPARATOR
SUGGESTED MANNINGS VALUES IN BLUE TEXT
SURVEYED BY GPS TO OSNG. LEVEL DATUM OSGM15.
ALL SECTIONS SHOWN PERPENDICULAR TO WATERCOURSE

Light | Trees | stone

5 0 5 10 15 20 25m
Scale: 1/100 at A1; 1/200 at A3

Client	Project		
Abley Letchford Partnership Ltd Consulting Engineers 3 Tealgate, Charnham Park Hungerford, RG17 0YT	Loddon Garden Village Project Watercourses Survey Shinfield to Winnersh Reading		
Surveyed: W.M.	Apprd:	R.J.FLEW	
Date: November 2021	File Ref:	1829	
Scale: 1/100 at A0; 1/200 at A1	Datum	OSTN15/OSGM15	

INFOMAP
SURVEYS AND MAPPING
CHARTERED SURVEYORS
Seymours House
Sunnyside Road North
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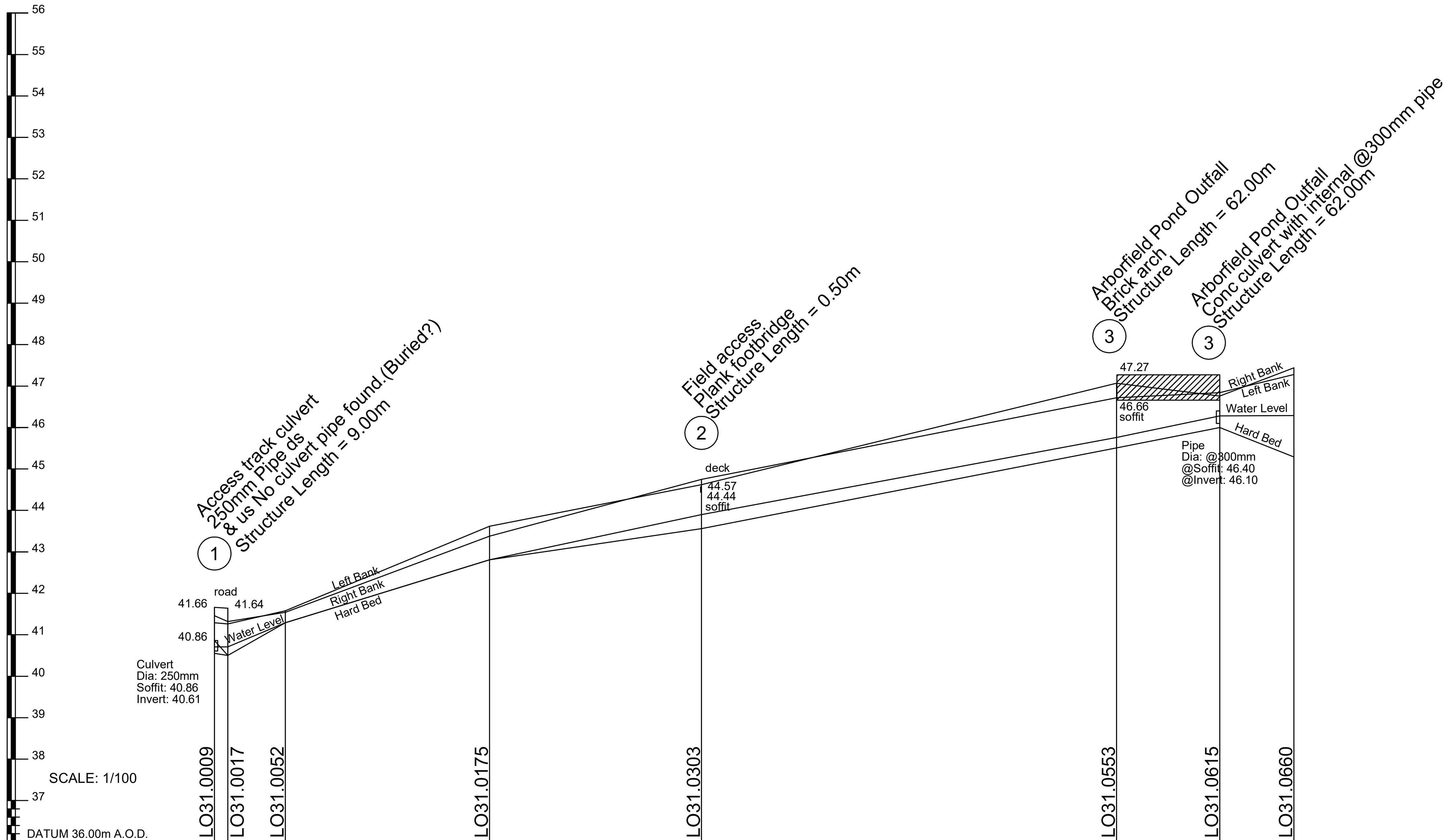
Tel: 01934 644060 /fax 01934 644060
E-mail: mail@infomapsurveys.co.uk
Website: www.infomapsurveys.co.uk
RICS
ISO 9001 REGISTERED FIRM

DRAWING REFERENCE

ISM/LODDON GARDEN VILLAGE PROJECT:
LO31 - Arborfield pond channel,
LO32 - Arborfield pond channel tributary

ISM-LODDON GARDEN VILLAGE-LO31-LO32-X-01

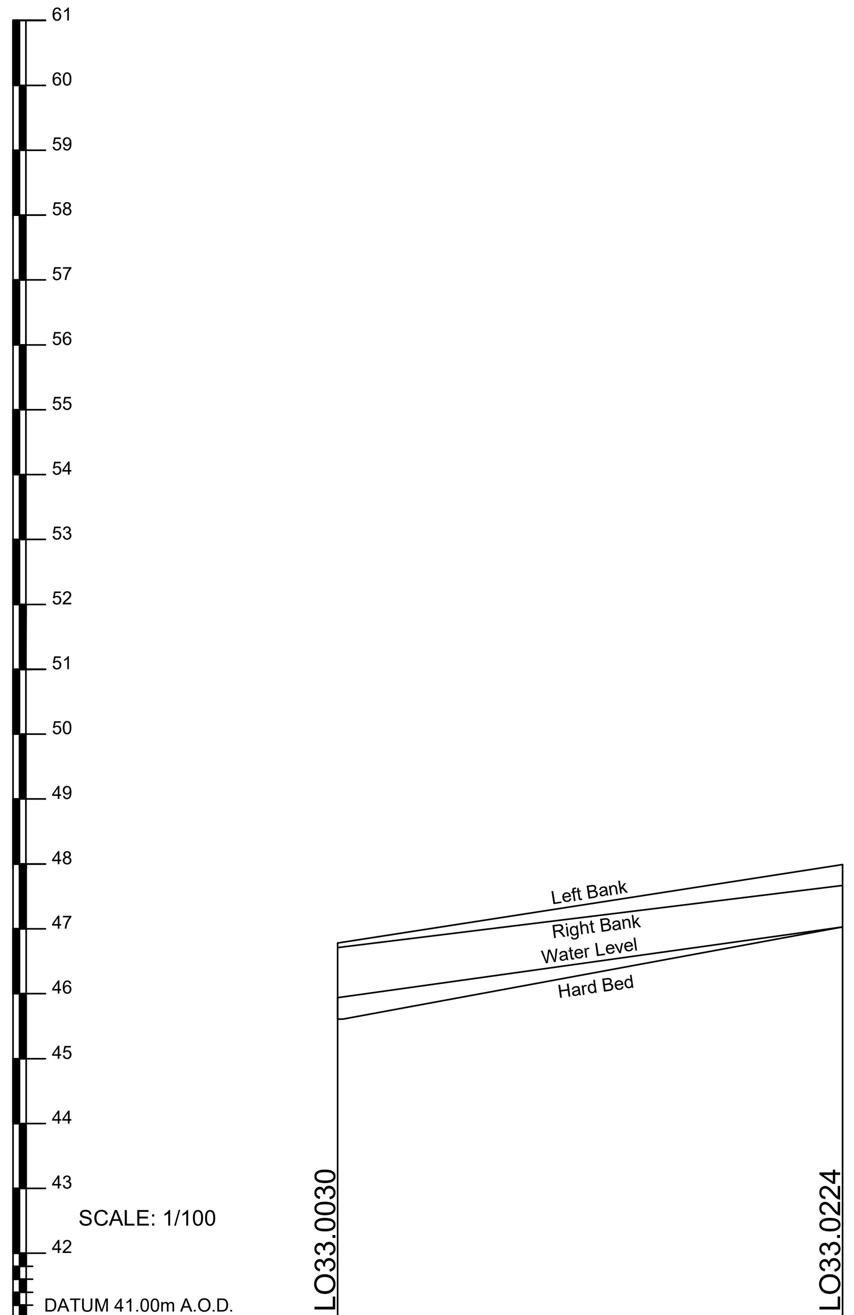


	LO31.0009	LO31.0017	LO31.0052	LO31.0175	LO31.0303	LO31.0553	LO31.0615	LO31.0660
BED MATERIAL	soil	soil	soil	soil	soil	gravel	concrete	gravel
LEFT BANK LEVEL	41.46	41.32	41.54	43.38	44.75	46.72	46.84	47.28
RIGHT BANK LEVEL	41.29	41.26	41.58	43.62	44.62	47.07	46.76	47.44
WATER LEVEL	40.71	40.71			43.90	45.76	46.28	46.29
SOFT BED LEVEL								
Hard Bed Level	40.55	40.50	41.29	42.81	43.56	45.51	46.00	45.29
REGRADE								
CHAINAGE	9	17	52	175	303	553	615	660

WATER COURSE Arborfield pond channel (LO31)

LONG SECTION Ch. 0009 TO 0660

Water Levels taken 25/11/2022 to10/01/2023



	LO33.0030	LO33.0224
BED MATERIAL	soil	soil
LEFT BANK LEVEL	46.78	47.99
RIGHT BANK LEVEL	46.71	47.67
WATER LEVEL		
SOFT BED LEVEL		
Hard Bed Level	45.94	47.03
REGRADE		
CHAINAGE	30	224

WATER COURSE Church Lane ditch (LO33)

LONG SECTION Ch. 0030 TO 0224

Water Levels taken 09/12/2022

STRUCTURE SECTION

STRUCTURE No.WITH NAME (1)

SURVEYED BY GPS TO OSNG. LEVEL DATUM OSGM15.

100 0 100 200 300 400 500m

Scale: 1/2500 at A1; 1/5000 at A3

Client	Project
Abley Letchford Partnership Ltd Consulting Engineers 3 Tealgate, Charnham Park Hungerford, RG17 0YT	Loddon Garden Village Project Watercourses Survey Shinfield to Winnersh Reading

Surveyed: W.M, H,L	Apprd:	R.J.FLEW	
Date: Jan 2022	File Ref:	1829	
Scale: 1/2500 at A1; 1/5000 at A3	Datum	OSTN15/OSGM15	

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E-mail: mail@infomapsurveys.co.uk
Website: www.infomapsurveys.co.uk
RICS
ISO 9001 REGISTERED FIRM

DRAWING REFERENCE

ISM/LODDON GARDEN VILLAGE PROJECT:
LO31 - Arborfield Pond Channel, LO33 - Church Lane Ditch,

ISM-LODDON GARDEN VILLAGE-LO31-LO33-L