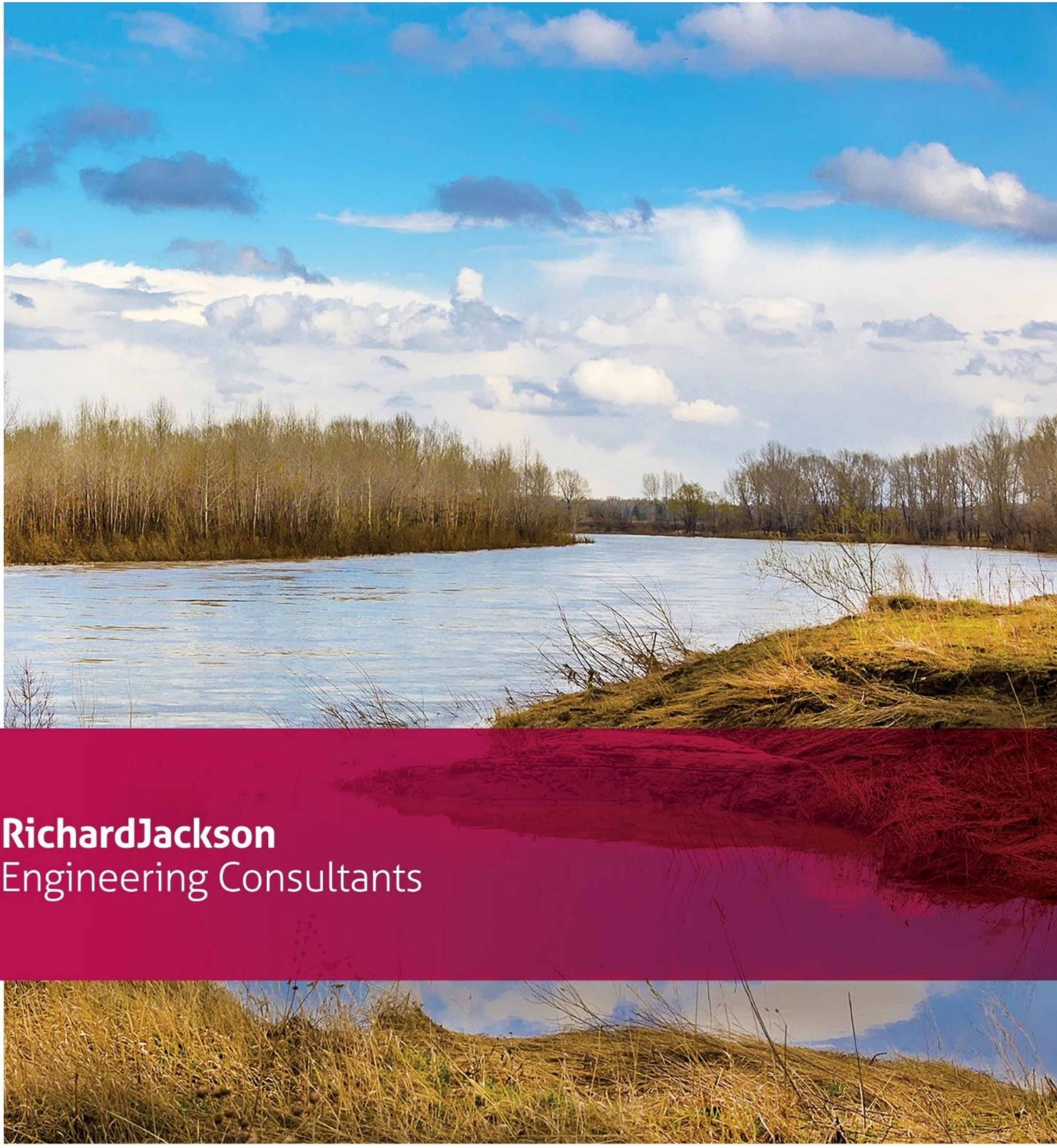

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SURFACE WATER STRATEGY

Alington Estate, Little Barford, Bedfordshire

The Executors of the Late Nigel Alington

August 2021

Project no: 60830

RichardJackson
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Document Review Sheet: -

Original Document prepared by: - [redacted]
on behalf of [redacted]

Date: - 11 August 2021

Original Document checked by: - [redacted]
on behalf of [redacted]

Date: - 12 August 2021

Original Document approved by: - [redacted]
on behalf of [redacted]

Date: - 12 August 2021

Document Status

DRAFT ☐

FINAL ☒

Revision Status

Issue	Date	Description	Prepared	Checked	Approved

Contents:-

Figures / Drawings

Appendices

1. INTRODUCTION

1.1. [redacted] has been commissioned by The Executors of the Late Nigel Alington to undertake a Surface Water Strategy (SWS) in support of a development site in Little Barford see **Figure 1** for the extents of the assessment.

1.2. The SWS will be completed in accordance with the National Planning Policy Framework (NPPF), Planning Practice Guidance (PPG) on Flood Risk and Coastal Change and the Bedfordshire Borough Council (BBC), Lead Local Flood Authority (LLFA) Guidance and Sustainable Drainage Supplementary Planning Policy dated Feb 2018, where applicable. The LLFA for this site will be BBC.

2. DEVELOPMENT SITE AND LOCATION

2.1. The site is bound by the River Great Ouse to the West and to the north the boundary of the site is the RWE power station and open farmland. To the south, the site has a boundary as indicated on **Figure 1** which is the extent of the land ownership. To the east is the East Coast Main Line (ECML) railway and farmland.

2.2. This location as highlighted on **Figure 1**, has an approximate Ordnance Survey midpoint of 518356E, 256536N and Postcode PE19 6YD.

2.3. The existing site comprises of agricultural land, farm buildings, a church and some residential dwellings of the agricultural estate.

2.4. The topographical survey data is shown on **Drawing 60830-PP-015 & 016**, which shows ground levels with additional Ordnance Survey data contours of the site and the site falls from the east to the west, where levels are approximately 45.0m to 50.0m Above Ordnance Datum (AOD) along the eastern boundary to a level of 14.5m to 15.0m AOD in the west alongside the Great River Ouse, thus the site has a gradient of ranging from approximately 1 in 34 to 1 in 163 from east to west.

2.5. The current land has a higher land classification of "More Vulnerable" according to Table 2:Flood Risk Vulnerability Classification guidance in the Flood Risk and Coastal Change on the 'Gov.uk' website and planning policy data. More vulnerable uses are listed as appropriate development for Flood Zones 1 & 2, see Table 3:Flood Risk Vulnerability and Flood Zone Compatibility, to which this site mainly lies – refer to the flood map for planning in **Appendix A**.

3. DEVELOPMENT PROPOSALS

3.1. The site is proposed for a change of use from mainly agricultural land uses and associated housing to residential and employment with some mixed use on the site.

3.2. The proposed uses have a higher flood risk classification of "More Vulnerable" which is the same as the highest classification for the existing uses, thus in reality there is no change in flood risk classification. The anticipated design life of this development will be 100 years.

4. SEQUENTIAL TEST

4.1. As this site is located in Flood Risk Zone (FRZ) 1 and 2 the sequential test for the flood risk areas will be considered and development outside of FRZ 2 will be applied.

4.2. FRZ1 which is considered to be at very low risk to fluvial and/or tidal flooding as well as being at low risk of surface water flooding (refer to **Section 6** for more detail), will be the appropriate development areas and thus the Sequential Test has been applied to identify the potential development areas of the site.

5. CLIMATE CHANGE

5.1. Climate change over the next 100 years or so is predicted to increase the probability of surface water flooding, as peak rainfall is predicted to significantly increase. Therefore, it is proposed to factor in a 40% climate change allowance, in accordance with the PPG on rainfall intensity for developments of a design life of 100 years and also the LLFA guidance.

5.2. In terms of the climate change allowances for the impacts on Fluvial Flooding, reference is made to the details provided by the Environment Agency (EA) which can be found in **Appendix B**. This data suggests that for sites classified as "More Vulnerable", as this site, an "upper end" allowance should be considered for climate change which is indicated as 65% for the Anglian River Basin District and for the lifetime of the development. This percentage will be used to calculate the Great River Ouse flood levels with climate change added.

6. SITE SPECIFIC FLOOD RISK ASSESSMENT

6.1. The 'Gov.uk' website flood mapping for this site has been reviewed and other sources of flood information including data from BCC, the EA and Internal Drainage Board (IDB) Bedford Group.

6.2. There are five main sources of flooding that have the potential to affect development and therefore must be assessed for their potential to flood the development and to increase the risk of flooding to others. The main sources of flooding that need to be considered are as follows:

- Fluvial and/or tidal flooding;
- Overland surface water flooding;
- Overloading of the existing drainage network;
- Ground water flooding; and
- Artificial flood sources.

Fluvial and Tidal Flooding

6.3. Fluvial and tidal flooding occurs when the natural capacity of a river system or sea defence (natural or manmade) is reached. The site is located within FRZ 1 and 2 (as shown on mapping in **Appendix A**) and abuts the River Great Ouse to the west, with eastern parts of the site being in FRZ 1. An indication of the associated flood mapping is shown on **Figure 2**.

6.4. To understand the local responsibilities or watercourses in the area of the site an assessment of the BBC Areas of Responsibilities, mapping, has been considered. See **Appendix C** for details. An assessment of the local watercourses and rivers has indicated that the River Great Ouse is a main river as classified by the Environment Agency as indicated in **Appendix C**. The site is outside the area controlled by the Internal Drainage Board.

6.5. Notwithstanding the above, modelled fluvial flood level data for the River Great Ouse has been obtained from the EA for various flood events, including the 0.1% Annual Exceedance Probability (AEP), 1 in 100 plus climate change and 0.1% AEP, 1 in 1000 year flood events. This data is provided in **Appendix D**, dated 03 March 2021**.**

6.6. The EA flood level data indicates that the nearest recorded Modelled Flood Level Node Points for the River Great Ouse are as listed below, located west of the site. The associated fluvial flood levels are as indicated below, which have been extrapolated from the data provided by the EA and the graphs showing the extrapolation are in **Appendix E**.

Table 6.1 – EA River Great Ouse Flood Node Levels Plus CC

Node Point	1% AEP (1 in 100)	1% AEP (1 in 100) + 20%CC	1% AEP (1 in 100) + 65%CC	0.1% AEP (1 in 1000)
EA052349UO0118	16.27	16.42	16.73	16.73
EA052349UO0119	16.28	16.43	16.73	16.74
EA052349UO0120	16.39	16.44	16.71	16.75
EA052349UO0121	16.34	16.49	16.81	16.79
EA052349UO0122	16.39	16.54	16.91	16.83
EA052349UO0123	16.46	16.61	17.02	16.91
EA052349UO0124	16.50	16.65	17.12	16.94
EA052349UO0125	16.53	16.68	16.89	16.97
EA052349UO0126	16.58	16.72	16.95	17.00
EA052349UO0127	16.62	16.75	17.06	17.01
EA052349UO0128	16.70	16.81	17.16	17.06
EA052349UO0129	16.77	16.90	17.22	17.16

Source: Environment Agency. Fluvial Flood Levels - mAODN. CC= Plus Climate Change

6.7. The flood level data has been shown on the topographical survey on **Drawing 60830-PP-012A** to indicate the effects of the 1% AEP (1 in 100) plus 65% climate change river flooding or 0.1%AEP (1 in 1000) storm whichever is the higher indicated in **Table 6.1**.

Surface Water Flooding

6.8. An investigation into the surface water flooding in the local area of the site via the 'Gov.uk' maps, as shown on **Figure 3** (high risk) indicates some minor risk of surface water flooding in the centre of the site near Lower Farm and also near the railway underpass along the route of the ditch towards the River Great Ouse, relating to the 3.33% AEP (1 in 30 year) event.

6.9. For the Medium Risk Scenario (up to the 1.0% AEP), shown on **Figure 4** there is some minor flooding between 300mm and 900mm along the route of the ditch mentioned above.

6.10. For the Low risk 0.1% AEP (1 in 1000 year) event on **Figure 5**, the site is shown to be at risk of surface water flooding which appears to be mainly from the railway underpass and the associated watercourse to the west of the railway line, which then flows towards the River Great Ouse.

6.11. Consideration should be given to the surface water flow routes on any proposed development scheme and exceedance routes to ensure that a safe route to exit can be maintained in an extreme event. Our assessment of the 0.1% AEP event indicates that being able to exit the site avoiding the overland flow can be completed, showing that it is not detrimental to the development or an escape route.

Overloading of Existing Drainage Network

6.12. Flooding can occur when the drainage capacity of the network is exceeded or fails. This can be due to the design capacity of the network being less than the return period of the rainfall event. Otherwise, it can be when the network does not perform to the design capacity due to blockage or damage within the network. In addition, it can also occur if a water main fails. The water main and sewer plans can be found in **Appendix F**.

6.13. An assessment of the existing potable water network has been completed and there appears to be water mains parallel to Barford Road and these will need to be avoided with any future development.

6.14. An assessment of the surface water sewerage system locally indicated there are no surface water sewers within the site boundary.

6.15. There are foul water sewers within the site and these are positioned in the centre of the site near to Lower Farm, leading to a sewage treatment plant just to the north of Lower Farm. These will need to be avoided with any future development.

Groundwater Flooding

6.16. Groundwater flooding occurs when the water table rises. As such, groundwater flooding can happen sometime after a rainfall event and can last a considerable length of time.

6.17. Consideration has been given the groundwater vulnerability and this is indicated on **Figure 6**. The site is shown to be in a potential medium to low or low, Groundwater Vulnerability area.

6.18. The ground investigation records of the borehole (TL15NE119, taken from the BGS website) on the northern boundary of the site just south of the tree belt and RWE Power Station indicates that the ground water was not encountered to a depth of approximately 2.37m. The ground level of the borehole was 17.3m AOD, thus the groundwater would likely be at a level of approximately 14.93m.

6.19. The conclusion is that the groundwater level is not extremely deep and consideration to groundwater should be considered in the design of the proposed development and a surface water solution.

Artificial Sources of Flooding

6.20. A view of the Reservoir flooding risk to the site has also been assessed via the 'Gov.uk' mapping and shows no risk beyond that already identified earlier in this report, so it has not been investigated further.

7. SURFACE WATER MANAGEMENT

7.1. It is proposed to change the existing site from agricultural uses and dwellings to further residential and employment uses.

7.2. It has been determined using the Ordnance Survey and topographical survey level information available, that surface water runoff from the site may occur in a westerly direction towards the River Great Ouse. Some of the rainfall falling across the existing site will also infiltrate into the soils of the site given the current permeable surfaces of agricultural land.

7.3. To determine the rainfall data for the site, the Flood Estimation Handbook (FEH) data has been established, see **Appendix G**. The FEH data for rainfall is suggested by the LLFA as being the correct dataset to use. To establish the parameters for rainfall run off from the site, two areas of FEH data have been used as there are, in the main, two catchment areas. These areas are firstly the areas that flow to the River Great Ouse and secondly, those areas that flow towards the watercourse to the north east of the site towards Rectory Farm. The appropriate catchment rainfall details will be used for the land parcels falling towards those catchments.

Soil Types and SuDS Suitability

7.4. The NPPF and appropriate guidance indicates that the FRA should identify the risks of flooding and manage those risks to ensure the site remains safe. One way to manage the flood risk is to incorporate Sustainable Drainage Systems (SuDS) within proposals for new sites. There is a general requirement that SuDS be installed where appropriate, in order to limit the amount of surface water into the ground to follow its natural drainage path. This advice is also replicated in the SuDS Manual C753 (2015).

7.5. No site investigation has been undertaken as yet which would include infiltration testing at the site. On the basis of the data gained from other sources, it is therefore considered that the ground condition will not be suitable for typical infiltration methods, due to the presence of clay. Further investigation in to the ground conditions will be needed at a later date.

7.6. Advice on pollution control is given in the SuDS Manual C753 (2015). To provide data that indicates sufficient pollution protection to improve water quality, an assessment of the 'Water Quality Risk Management' has been undertaken in accordance with Chapter 26 of the Ciria C753 SuDS Manual 2015. **Table 26.2** identifies the pollution hazard indices for different land use classifications. The pollution levels for this site are indicated below as taken from Chapter 26, **Table 26.2**, for property driveways, roofs and the highways.

TABLE 26.2 Pollution hazard indices for different land use classifications

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/ industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways[1]	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways[1]	High	0.8[2]	0.8[2]	0.9[2]

Notes

1 Motorways and trunk roads should follow the guidance and risk assessment process set out in Highways Agency (2009).

2 These should only be used if considered appropriate as part of a detailed risk assessment – required for all these land use types (Table 4.3). When dealing with high hazard sites, the environmental regulator should first be consulted for pre-permitting advice. This will help determine the most appropriate approach to the development of a design solution.

Table 26.2 – Ciria C753 (2015)

7.7. The development is likely to have five main site areas. The relevant indicated pollution hazard indices for these are set out below in **Table 7.1**;

Table 7.1 – Pollution Indices for the Various Aspects of the Development

	Low TSS=0.5 Metal=0.4 H-carbons=0.4	**Very Low TSS=0.2 Metals=0.2 H-carbons=0.05**	**Medium TSS=0.7 Metals=0.6 H-carbons=0.7**
Private Drives	✓		
Private Roofs		✓	
Highways <300 movements per day*	✓		
Highways >300 movements per day			✓
Commercial Areas			✓

*This equates to ciria 50 dwellings

7.8. An assessment of which SuDS features are applicable when discharging to watercourses, see **Table 26.3,** for discharging to surface waters from SuDS Manual C753 (2015), has been completed. This is required in order to protect the watercourses, the feature is discharging into.

TABLE 26.3 Indicative SuDS mitigation indices for discharges to surface waters

Type of SuDS component	Mitigation indices[1] TSS	Metals	Hydrocarbons
Filter strip	0.4	0.4	0.5
Filter drain	0.4[2]	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention system	0.8	0.8	0.8
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond[4]	0.7[3]	0.7	0.5
Wetland	0.8[3]	0.8	0.8
Proprietary treatment systems[5,6]	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

Notes

1. SuDS components only deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters.
2. Filter drains can remove coarse sediments, but their use for this purpose will have significant implications with respect to maintenance requirements, and this should be taken into account in the design and Maintenance Plan.
3. Ponds and wetlands can remove coarse sediments, but their use for this purpose will have significant implications with respect to the maintenance requirements and amenity value of the system. Sediment should normally be removed upstream, unless they are specifically designed to retain sediment in a separate part of the component, where it cannot easily migrate to the main body of water.
4. Where a wetland is not specifically designed to provide significantly enhanced treatment, it should be considered as having the same mitigation indices as a pond.
5. See Chapter 14 for approaches to demonstrate product performance. A British Water/Environment Agency assessment code of practice is currently under development that will allow manufacturers to complete an agreed test protocol for systems intended to treat contaminated surface water runoff. Full details can be found at: **http://tinyurl.com/qf7yuj7**
6. SEPA only considers proprietary treatment systems as appropriate in exceptional circumstances where other types of SuDS component are not practicable. Proprietary treatment systems may also be considered appropriate for existing sites that are causing pollution where there is a requirement to retrofit treatment. SEPA (2014) also provides a flowchart with a summary of checks on suitability of a proprietary system.

Table 26.3 – Ciria C753 (2015)

7.9. To ascertain which SuDS features could be applied to the SuDS for the scheme, the comparison **Table 7.2** below indicates the acceptability given the pollution indices for the development areas across the site.

Table 7.2 – SuDS Selection

Type of SuDS	Private Roofs TSS=0.2 Metals=0.2 H-carbons=0.05	Private Drives TSS=0.5 Metal=0.4 H-carbons=0.4	Highways (Low) TSS=0.5 Metals=0.4 H-carbons=0.4	Commercial/Highways* (Medium) TSS=0.7 Metals=0.6 H-carbons=0.7
Filter Strip	✓			
Filter Drain	✓			
Swale	✓	✓	✓	
Permeable Paving	✓	✓	✓	✓
Detention Basin	✓	✓	✓	
Pond	✓	✓	✓	✓
Wetland	✓	✓	✓	✓
Soakaway	✓	✓	✓	
Infiltration Trench/Basin	✓			
Proprietary Product	✓	✓	✓	✓

*Note: to reach the correct level of pollution indices in some circumstances, more than one SuDS can be combined using 50% of the second indices to achieve the desired level.

7.10. In ascertaining which SuDS features are applicable, the comparison **Table 7.3** indicates the acceptability for the pollution indices for the site.

7.11. To show how the pollution indices can be met, **Table 7.3** below shows how the various SuDS selection will contribute towards pollution indices.

Table 7.3 – SuDS Selection/Comparison to the higher pollution indices values

Type of SuDS	**Private Roofs /Drives TSS=0.5 Metal=0.4 H-carbons=0.4**	**Highways (Low) TSS=0.5 Metal=0.4 H-carbons=0.4**	**Commercial/Highways (Medium) TSS=0,7 Metals = 0.6 H-Carbons=0.7**
Detention Basin	✓	✓	✓
Swale	✓	✓	✓
Permeable Paving	✓	✓	
Pollution Indices Values	Detention Basin TSS=0.5 Metals=0.5 H-carbons=0.6	Detention Basin TSS=0.5 Metals=0.5 H-carbons=0.6	Swale & Detention Basin TSS=0.5 + (0.5/2) = 0.75 Metals=0.6 + (0.5/2) = 0.85 H-carbons=0.6 + (0.6/2) = 0.9
Acceptable as pollution control (Y/N)	Yes	Yes	

7.12. Using **Table 7.3** which is derived from **Table 26.2** and **26.3** of Ciria C753 then it can be concluded that the better SuDS' choices for the site are as set out below;

- Highways - Highway drainage via swales/sewers to a detention basin
- Private Drives – Permeable Paving and detention basin
- Residential Roofs – Permeable Paving and detention basin
- Commercial Areas - Via swales and detention basins where possible

7.13. Highway drainage will flow via swales/sewers to detention basins to mitigate the medium pollution risk. These basins will be sought to be adopted by the Highway Authority or Water Authority who will ensure correct maintenance takes place throughout their design life.

7.14. A surface water strategy for the dwellings/commercial area is proposed to utilise the permeable paving for the drives where roof water can discharge into the existing soils, if infiltration allows. The permeable paving depths can be designed for events up to the 1 in 100 year storm event, plus climate change at 40% once infiltration rates are known or they can act as a SuDS pollution feature prior to a detention basin if needed. This is based on the SuDS management train.

Surface Water Design

7.15. When considering surface water drainage from impermeable areas, it is often assumed that there will be 100% runoff, thus, providing the most onerous calculation. For the purpose of this report, we have assumed the worst case scenario that there will be 100% runoff from the proposed impervious surfaces.

7.16. All the drainage has been designed using the FEH rainfall data as the LLFA/Ciria C753 guidance stipulates and the run off has been reduced to Greenfield run off for each catchment area using the 'UKSuDS Greenfield Runoff Tool'. The site has been split into development areas and the greenfield runoff for each area has been calculated, see **Appendix H**. The site has been split in five catchments and the appropriate run off is set out below in **Table 7.4**.

Table 7.4 – Greenfield Run off Calculations

Greenfield Run off Areas	Site	Area (Ha)	Greenfield Run off Rate Q Bar L/S	Greenfield Run Off Rate Prorata L/S	% Imp Area	Prorata GFR
1	1	)	)	)	)	)
	2	) 8.85	)	) 18.1	) 74	) 13.4
	3	)	) 46.47	)	)	)
	4	7.34	)	15.0	50	7.5
	5	1.60	)	3.3	50	1.65
	6A	4.89	)	10.0	50	5.0
1E	1E (south west of the site)	20.5	42.53	42.53	54	22.97
6, 7, 8 & 9	6B	7.84	)	6.28	50	3.14
	7	1.23	) 25.55	0.98	50	0.50
	8	17.71	)	14.3	50	7.15
	9	4.97	)	3.99	50	2.0
10A & 12 to 18	10A	29.72	21.06	21.06	50	10.53
10B & 11	10B	14.68	) 17.0	11.74	50	5.87
	11	6.57	)	5.26	50	2.63
10A & 12 to 18	12	24.84	17.60	17.6	50	8.8
	13	7.27	5.15	5.15	50	2.6
	14	4.55	3.22	3.22	50	1.6
	15A	10.84	7.68	7.68	50	3.84
	15B	6.94	4.91	4.91	50	2.45
	16	9.04	6.4	6.4	50	3.2
	17	13.21	9.36	9.36	50	4.68
	18	10.84	7.68	7.68	50	3.84

7.17. Once the greenfield run off rates and impermeable areas have been established, an assessment of the amount of attenuation can be calculated. The volumes of storage of surface water are set out for each area of development indicated in **Table 7.5**. These volumes have been calculated using the MicroDrainage Quick Storage Calculation program, see **Appendix I** for details.

Table 7.5 – Development Areas, GFR and Attenuation Volumes

Greenfield Run off Areas	Site	IMP Area (Ha)	Greenfield Run off Rate L/S	Attenuation Volumes Using MicroDrainage Quick Storage (M^3)
1	1	)	)	)
	2	) 6.85	) 13.4	) 6164
	3	)	)	)
	4	Not used	-	-
	5	0.8	1.65	745
	6A	2.45	5.0	2294
1E	1E	11.25	22.97	10534
6, 7, 8 & 9	6B	3.92	3.14	4220
	7	0.615	0.5	660
	8	8.86	7.15	8a = 3787 8b = 5723
	9	2.45	2.0	9a = 880 9b = 1441 9c = 331
10A & 12 to 18	10A	14.86	10.53	16258
10B & 11	10B	7.34	5.87	7944
	11	3.29	2.63	3568
10A & 12 to 18	12	12.42	8.80	13584
	13	3.64	2.60	3976
	14	2.28	1.60	2497
	15A	5.42	3.84	5936
	15B	3.47	2.45	3787
	16	4.52	3.20	4944
	17	6.61	4.68	7225
	18	5.42	3.84	5936

7.18. The storage volumes have been established for the 1.0% AEP storm event or 1 in 100 year event with an allowance for 40% climate change and assuming 90% impermeable areas for retail / commercial sites and 50% impermeable areas for residential sites across the whole development allocations, where detention basins are assumed to have a water depth of approximately 1.0m.

7.19. The 1 in 100 events plus 40%+CC, storage areas for basins are indicated on the **Drawings 60830-PP-200 to 204.**

7.20. The exceedance event flow routes are indicated on **Drawings 60830-PP-2000 to 204** also.

Influence of the Surface Water Overland Flow Areas above 1 in 100 Storm

7.21. To ensure that the drainage strategy can be implemented, the existing overland surface water flooding areas have been plotted onto the topographical survey and are indicated on **Drawings 60830-PP-200 to 204**. The storage areas for surface water have been placed to avoid these overland flood areas for the 1 in 100 year events.

7.22. In certain areas, other existing infrastructure such as overhead power cables less than or equal to 11kv may need diverting, so too for the water mains.

7.23. In the north east of the site, as the catchment falls towards the north east away from the River Great Ouse, separate connections to the respective receiving catchment watercourse may need to be made, via Rectory Farm.

7.24. In all other areas of the site, the attenuated water will flow across the development areas via pipes or ditches from east to west towards the River Great Ouse.

7.25. The existing greenfield run off is approximately 214.6l/s. Once attenuated the flow from the development sites will be reduced to 105.82l/s, for the development areas.

Flood Risk Elements

7.26. In terms of the FRZ 2, this has been addressed in the Flood Risk Report and an appropriate level across the site calculated. In accordance with national policy, it is suggested that no floor levels should be a minimum of whichever is the higher of:

- 300 millimetres (mm) above the general ground level of the site
- 600mm above the estimated river or sea flood level.

7.27. On this site the highest flood level is 17.22m AOD (1.0% plus 65%CC) as **Table 6.1**, thus it is suggested that as a precaution the lowest floor level should be 17.85m AOD. Through agreement and careful consideration, the floor level may be able to be reduced to 17.34m AOD in the northeast of the site, which is 0.6m above the flood level of 16.74m AOD. The agreement of the floor levels may need to be agreed with the EA or LLFA, or be subject the needs of the surface water strategy which may govern the minimum floor level.

7.28. Whilst the figures above indicate minimum floor levels for avoidance of flood risk from the River Great Ouse, this does not consider the issues associated with the ability to drain the surface water from the site and to provide a non-surcharged outfall. To attenuate the water from the site and to ensure a free flowing outfall, the detention basins may need a minimum level of 17.4m in the south west corner of the site and 17.00m in the north west corner of the site. With a minimum of 1.0m depth, this requires the ground level in the south west corner of the site in the area 1E to be at a level of approximately 18.50m AOD. In the north west corner of the site, the minimum floor level is required to be at least 18.00m AOD.

8. OCCUPANTS AND USERS OF THE DEVELOPMENT

8.1. As the site is proposed for a change of use, from mainly agricultural to residential and employment, consideration to the users of the site will need to be addressed for the fluvial flood levels as well as the surface water flooding, for any accommodation or employment use, especially where occupants that may stay overnight.

9. EXCEPTION TEST

9.1. The exception test and assessment of the relevant flood levels with consideration to the appropriate climate change percentage has been completed. Development is proposed to be positioned in the areas of least flood risk, for example in FRZ 1, and outside of overland surface water drainage areas up to the 1 in 100 return period. Therefore the site will be acceptable for the proposed uses.

10. RESIDUAL RISKS

10.1. The residual risk is usually taken to refer to the portion of overall risk that remains once risk mitigation measures have been implemented.

10.2. Groundwater flooding could occur, however, there is no proposed basement development suggested at the present time and the recorded groundwater is approximately 2.5m below the existing ground level. As previously stated, groundwater flooding can cause disruption, but the slow onset of this type of flooding means that it is unlikely to cause a serious danger to life or property. Any flow from the site could be channeled toward the roads / driveways as well as green space away from buildings.

10.3. A surface water flood greater than the 1.0% Annual Exceedance Probability could occur, which may exceed the capacity of the existing drainage system and cause flooding to the site. However, the site is on a slight slope and with building located on higher ground and with appropriate exceedance routing the surface water could be mitigated.

10.4. Other sources of potential flooding might be water main failure, but these are rare and also failure of the Anglian Water, Water Recycling Centre (WRC) to the west of Barford Road near Lower Farm, however this has a monitoring station. Therefore these are unlikely to affect the development.

11. CONCLUSIONS

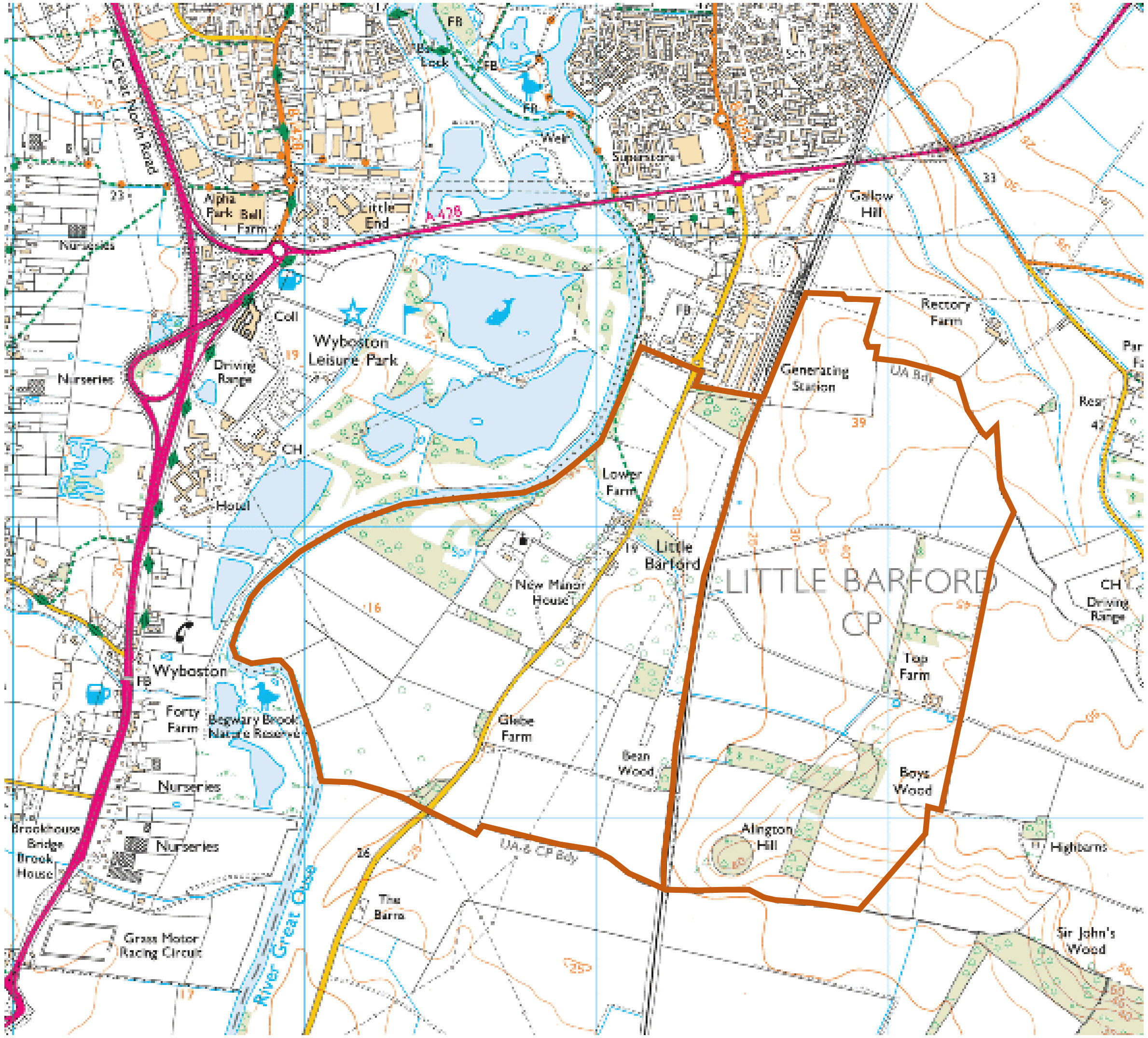
11.1. The site is location in an area of FRZ 1 and 2 and the development will be situated in Flood Zone 1 and is an appropriate for development for that zone according to the Planning Policy Guidance of the NPPF and the LLFA.

11.2. There will be no increase in water flow from the site given that the drainage strategy has been designed to accommodate the 1 in 100 year event plus 40% climate change within the surface water drainage system. Once the suitable mitigation strategy is in place and development located outside of the surface water flooding areas, there is a satisfactory drainage strategy for the site.

11.3. The existing surface water flooding routes have been considered and will need to managed away from the development areas, thus meeting the requirement of the local and national policy.

RichardJackson
Engineering Consultants

FIGURES / DRAWINGS



Site location grid reference 518356,256536 and postcode PE19 6YD

Client:	Drawing Title:		
Executors of the Late Nigel Alington	**Site Location Plan**		
Job Title:	Date:	Job No:	Dwg No:
Little Barford, Bedfordshire	**30.7.21**	**60830**	**Fig. 1 (NTS)**

RichardJackson Engineering Consultants

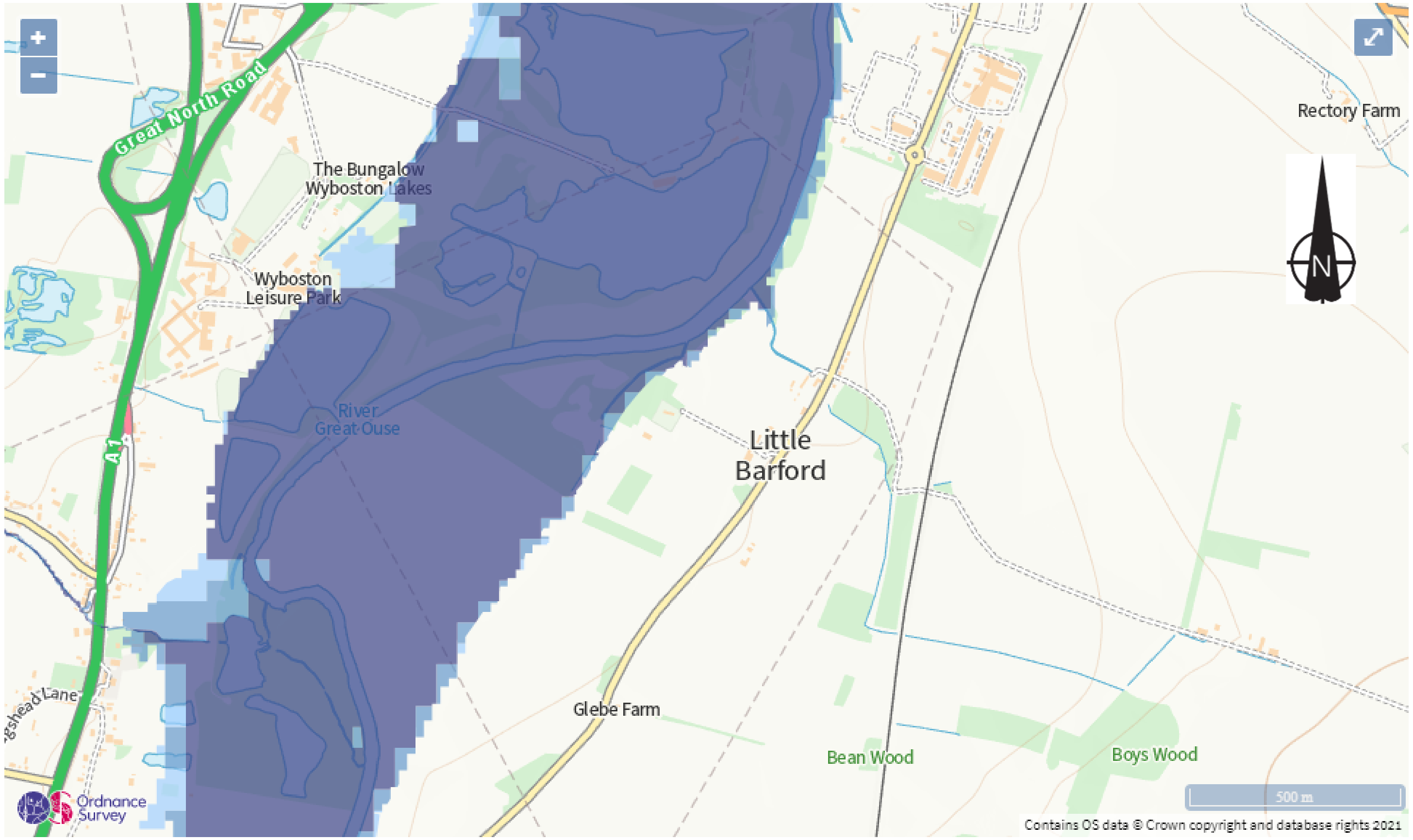
4 The Old Church, St Matthews Road, Norwich, NR1 1SP
Tel. 01603 230240
www.richardjackson.uk.com

Flood risk

Extent of flooding

Location

Enter a place or postcode



Extent of flooding from rivers or the sea

High   Medium   Low   Very low

Client:	Drawing Title:		
The Executors of the Late Nigel Alington	**Flood Mapping (High Risk)**		
Job Title:	Date:	Job No:	Dwg No:
Little Barford	**27.5.21**	**60830**	**Fig. 2 (NTS)**

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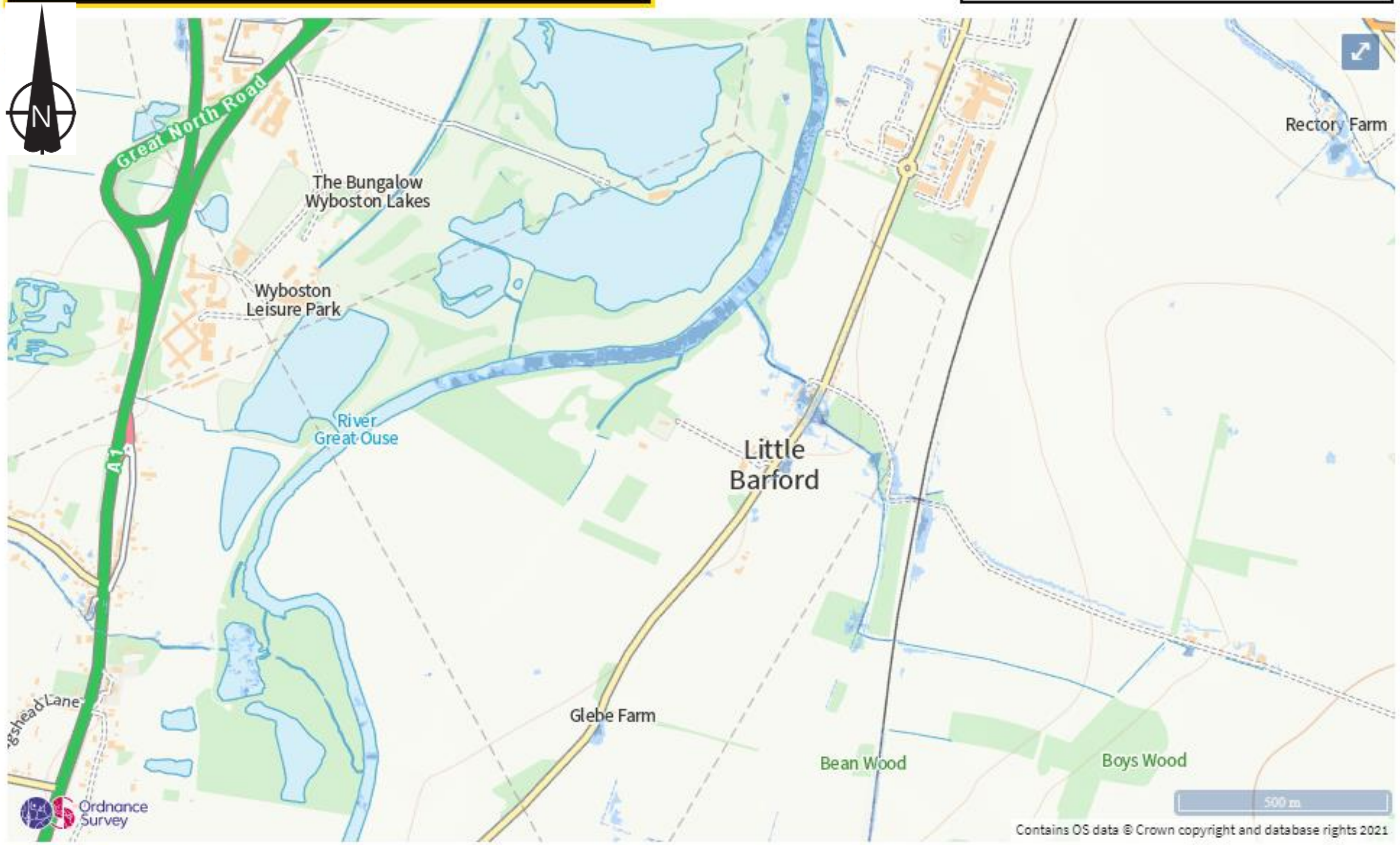
Flood risk

High risk: depth

Location

Enter a place or postcode



Surface water flood risk: water depth in a high risk scenario

Flood depth (millimetres)

Over 900mm | 300 to 900mm | Below 300mm

Client:	Drawing Title:		
The Executors of the Late Nigel Alington	**Surface Water Flooding (High Risk)**		
Job Title:	Date:	Job No:	Dwg No:
Little Barford	**27.5.21**	**60830**	**Fig. 3 (NTS)**

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Flood risk

Medium risk: depth

Location

Enter a place or postcode

Surface water flood risk: water depth in a medium risk scenario

Flood depth (millimetres)

Over 900mm | 300 to 900mm | Below 300mm

Client:	Drawing Title:		
The Executors of the Late Nigel Alington	**Surface Water Flooding (Medium Risk)**		
Job Title:	Date:	Job No:	Dwg No:
Little Barford	**27.5.21**	**60830**	**Fig. 4 (NTS)**

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Flood risk

Low risk: depth

Location

Enter a place or postcode

Surface water flood risk: water depth in a low risk scenario

Flood depth (millimetres)

Over 900mm | 300 to 900mm | Below 300mm

Client:	Drawing Title:		
The Executors of the Late Nigel Alington	**Surface Water Flooding (Low Risk)**		
Job Title:	Date:	Job No:	Dwg No:
Little Barford	**27.5.21**	**60830**	**Fig. 5 (NTS)**

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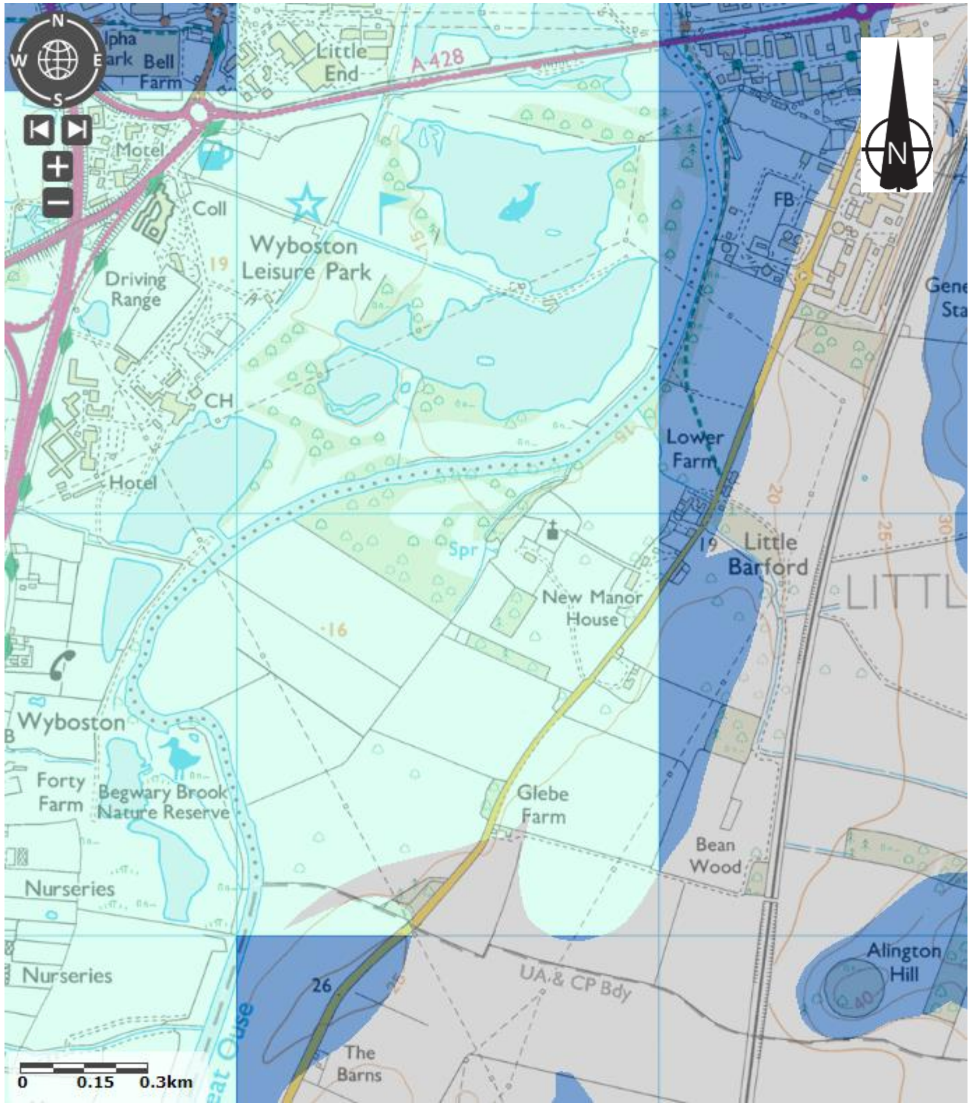

Groundwater Vulnerability Map (England)

- Local Information
- Soluble Rock Risk
- High
- Medium - High
- Medium
- Medium - Low
- Low
- Unproductive

Geological Places to Visit (England)

Client:	Drawing Title:		
The Executors of the Late Nigel Alington	**Groundwater Vulnerability**		
Job Title:	**Date:**	**Job No:**	**Dwg No:**
Little Barford	**27.5.21**	**60830**	**Fig. 6 (NTS)**

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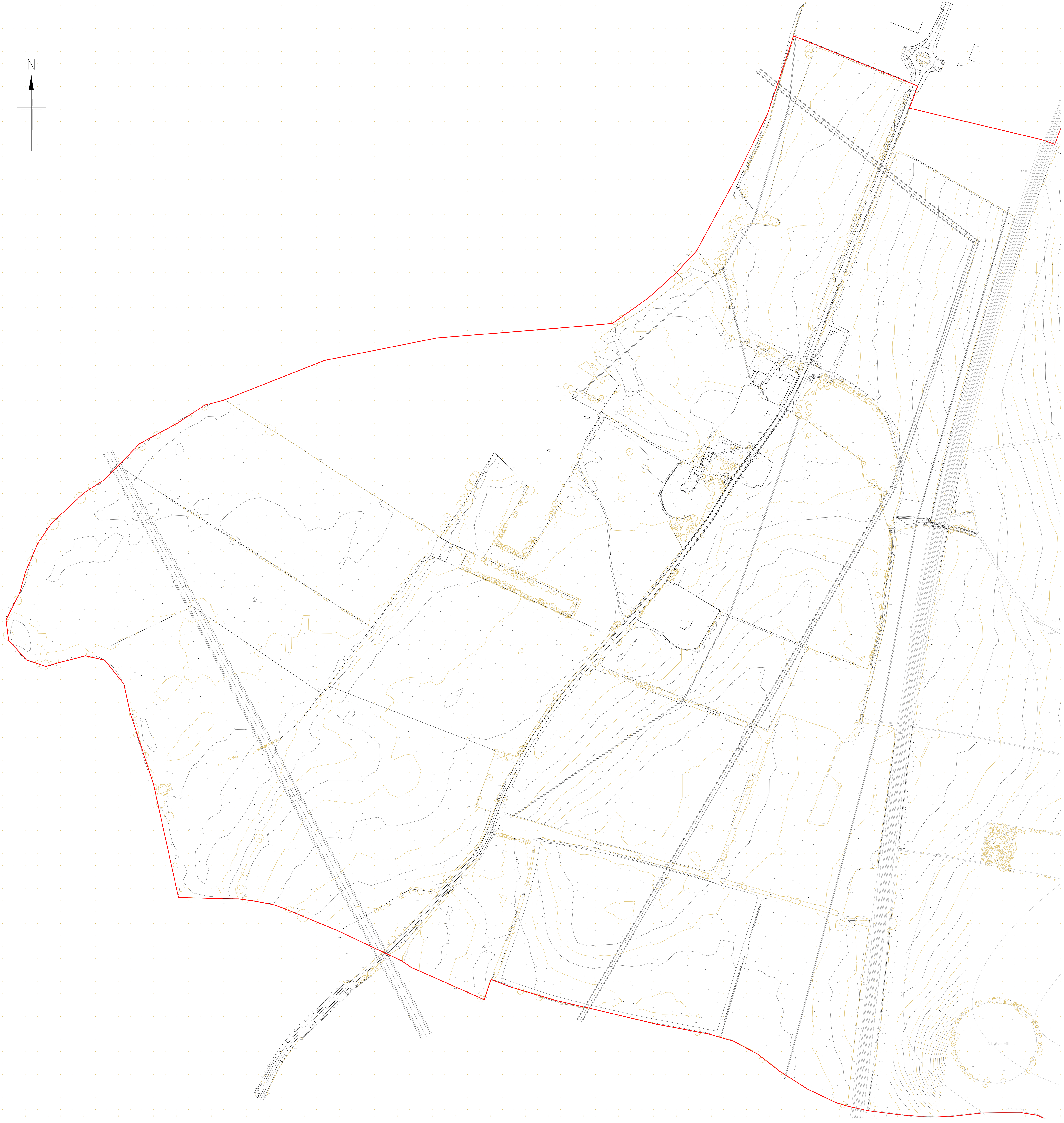
DO NOT SCALE



NOTES

1. ALL LEVELS ARE IN METRES ABOVE ORDNANCE SURVEY DATUM (mAOD).
2. THE TOPOGRAPHICAL SURVEY DATA WAS PROVIDED BY SURVEY SOLUTIONS LTD DATED 12.5.21, DRAWINGS 31109NOLS-05 TO 30, RICHARD JACKSON LTD ACCEPT NO LIABILITY FOR ERROR OR OMISSION WITH REGARD TO THE DATA CONTAINED WITHIN THE SURVEY.

KEY:

INDICATIVE SITE BOUNDARY

REV	DATE	DESCRIPTION	DRAWN	CHKD

REVISIONS

This drawing is to be read in conjunction with all other Engineer's drawings and all other project information. Any discrepancy between the Engineer's drawings and other project information is to be reported to the Engineer immediately.

ISO 9001 Registered Quality Management
UKAS MANAGEMENT SYSTEMS 015

Project
ALINGTON ESTATE, LITTLE BARFORD

Title
TOPOGRAPHICAL SURVEY
SHEET 1 OF 2

Client
THE EXECUTORS OF THE
LATE NIGEL ALINGTON

Scale	Drawn	Date
1:2500 @ A0	MJD	2.8.21
Job Manager	**Checked**	**Approved**
M DOUGHTY	RNL	MJD

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Drawing No.	Revision
60830-PP-015	

Drawing Status

☒ INFORMATION ☐ APPROVAL ☐ COSTING
☐ TENDER ☐ CONSTRUCTION ☐ AS CONSTRUCTED

A0