



Civil Engineers & Transport Planners

58 Finchampstead
Road

Flood Risk
Assessment &
Drainage Strategy

April 2024

241778/FRA_DS/OR/RS/01

Rev A



Civil Engineers & Transport Planners

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DOCUMENT STATUS

Project: 58 Finchampstead Road
Title: Flood Risk Assessment & Drainage Strategy
Client: Blueking Holdings Ltd
Reference: 241778/FRA_DS/OR/RS/01

Produced by: OR Date: 26/4/24
Checked by: RS Date: 26/4/24
Approved by: KL Date: 26/4/24

<u>Issue/revision</u>	<u>Date</u>	<u>Status</u>	<u>Issued by</u>
First	26/4/24	For Approval	RS
A	28/10/24	For Approval	KBL

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1 INTRODUCTION

1.1 Scope

1.1.1 Lanmor Consulting Ltd has been appointed to complete a Flood Risk Assessment & Drainage Strategy report for the proposed development at 58 Finchampstead Rd, Wokingham, RG40 2NS.

1.1.2 This report describes the existing and proposed development, the implications of flooding and the impact the proposed development will have on the flood plain in accordance with the government's guidance document: The National Planning Policy Framework (NPPF), with specific reference to its Planning Practice Guidance.

1.1.3 This report will consider the following:

- Location of the site;
- Development proposals;
- Existing information on extents and depths of flood events or on flood predictions;
- Sources of flooding;
- The impact of flooding on site.

1.1.4 This flood risk assessment has been prepared in accordance with the requirements of the National Planning Policy Framework and will demonstrate that the proposed development will be safe and will not increase the risk of flooding in the surrounding areas.

1.1.5 This report will also consider the proposed drainage regime for the site. It will assess the site's current Greenfield runoff rate, suitable methods of discharging the runoff from the development and set the drainage strategy for the proposed development, including discharge rates and any requirements for attenuation.

2 SITE CONDITIONS

2.1 Site Location

2.1.1 The site is located off Finchampstead Road, Wokingham, RG40 2NS. The area contains a high number of greenfield areas, with the majority of properties in the vicinity being used for residential purposes rather than commercial.

2.1.2 There is a railway line directly north of the site, which joins Bracknell and Wokingham stations. To the south of the site, approximately 100m from the existing residential buildings, resides the Emm Brook which is approximately 14.5km in length. This report aims to investigate the flood extents of this river, alongside any other factors which may contribute to flooding within the boundaries of the site.

2.2 Existing Site

2.2.1 The existing site is currently occupied by a single five-bedroom property with three outbuildings. The surface of the site is mainly grass and vegetation, with some hardstandings around the house. Ground levels across the site fall approximately 5m from northeast to southwest, with a ditch along the southern boundary that discharges to the Emm Brook.

2.3 Proposed Site

2.3.1 The proposed development consists of the demolition of the existing house and outbuildings and the erection of 4 five-bedroom detached houses with a new access road and turning head. The nearby ditch is to be cleaned and landscaped to form a feature and boundary to the site. The boundary fences will be permeable to allow flood waters to flow freely.

2.4 Site Geology

2.4.1 The site's bedrock geology consists of London Clay Formation, which consists of layers of clay, silt, and sand. Sedimentary bedrock formed on the site is approximated to be formed between 56 and 47.8 million years ago during the Palaeogene period. There are no records of superficial deposits on the site.

3 SOURCES OF FLOODING

3.1 Fluvial / Tidal Flooding

3.1.1 Flood mapping for planning has been provided by the Environment Agency (EA) for the site and surrounding area. The mapping indicates the site to be mostly within Flood Zone 1, with Flood Zone 3 encroaching into the southern boundary along the route of the watercourse.

3.1.2 The NPPF and PPG define the Flood Zones as follows:

- Zone 1: 'Low Probability' This zone comprises land assessed as having a less than a 1 in 1000 annual probability of river or sea flooding (<0.1%) in any year.
- Zone 2: 'Medium Probability' – This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5%-0.1%) in any year.
- Zone 3a: 'High Probability' – This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.
- Zone 3b: 'The Functional Floodplain' – This zone comprises land where water has to flow or be stored in times of flood. SFRAs should identify this Flood Zone (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood, or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes).

3.1.3 The EA mapping shows the site mostly to be within Flood Zone 1, with a probability of fluvial flooding less than 0.1% in any given year. Figure 3.1 below shows an extract from the Flood Maps for Planning. The site is located in Flood Zone 1 with only a small area in the southwest corner in Flood Zone 3. The Flood Zone 3 region has a fluvial flood probability of greater than 1% each year.

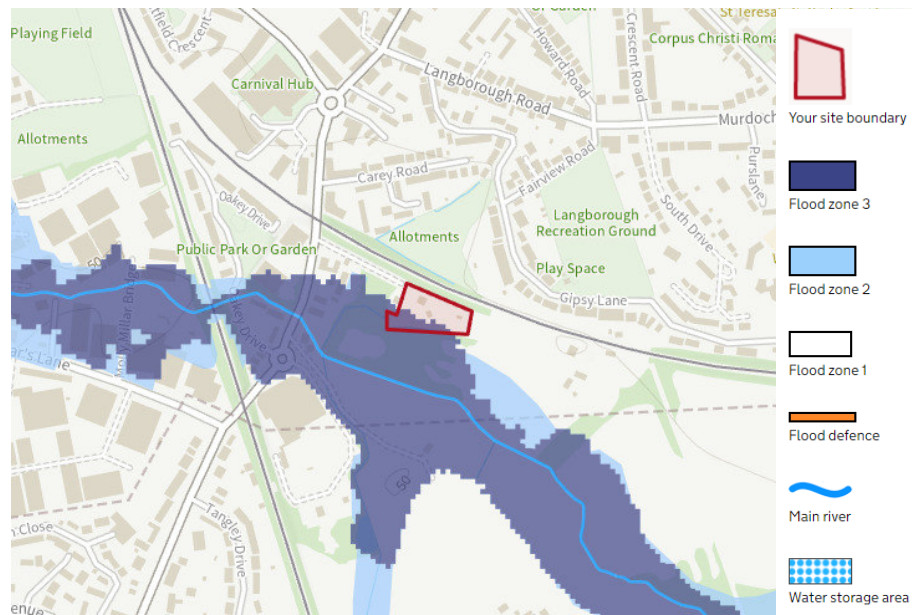


Figure 3.1 – Fluvial Flood Mapping

3.2 Surface Water Flooding

3.2.1 The EA describe the surface water flood extents as follows:

- Low Risk: 'Low Probability' This zone comprises land assessed as having between 0.1 and 1% chance of surface water flooding per annum
- Medium Risk: 'Medium Probability' This zone comprises land assessed as having between 1% and 3.3% chance of surface water flooding per annum
- High Risk: 'High Probability' This zone comprises land assessed as having greater than 3.3% chance of surface water flooding per annum

3.2.2 The site is demonstrated to be within close proximity to an area defined as having a low risk as well as high risk of surface water flooding. This means that there is a greater than 3.3% chance of surface water flooding which is restricted to the southwestern boundary of the site. However, the vast majority of the application site is within a region of no surface water flood risk or of low risk, particularly the area of the site under development.

3.2.3 Below is an image demonstrating the site boundaries in relation to the surface water flood mapping provided by the Environmental Agency.



Figure 3.2 – Surface Water Flood Risk

3.3 Groundwater Flooding

3.3.1 The borough of Wokingham published data in their SFRA regarding the risk of groundwater flooding to the site. Data on the mapping shows that there is a less than 25% risk of groundwater emergence in the local area.

3.4 Reservoir Flooding

3.4.1 The EA long-term flood risk mapping indicates that the site has a very low risk of flooding as a result of reservoir or dam failure.

4 MODELLED FLOOD EVENTS AND CLIMATE CHANGE

4.1 Flood Probability

4.1.1 The principal source of flooding to the site comes from the Emm Brook stream located to the south of the site. There is also a ditch passing along the southern boundary of the site, leading to the Emm Brook, that will be cleaned out as part of the works.

4.1.2 Detailed flood modelling was requested from the EA, and they have provided information on Products 5, 6 and 7 with the raw flood modelling. Flood level data for the scenario was extracted from the Product 6 model data, which are tabulated below in Table 4.1. There are no flood defences along the watercourses in the area.

4.1.3 The scenario modelled below shows the worse case scenario for the undefended watercourse using the topographical survey. The flood data points have been plotted against the surveyed levels to provide a more accurate plot of the extent of flood waters into the site. This modelling is considered to be more accurate than the EA flood map, as their modelling is based on LIDAR data ground levels, which can be less accurate than surveyed levels.

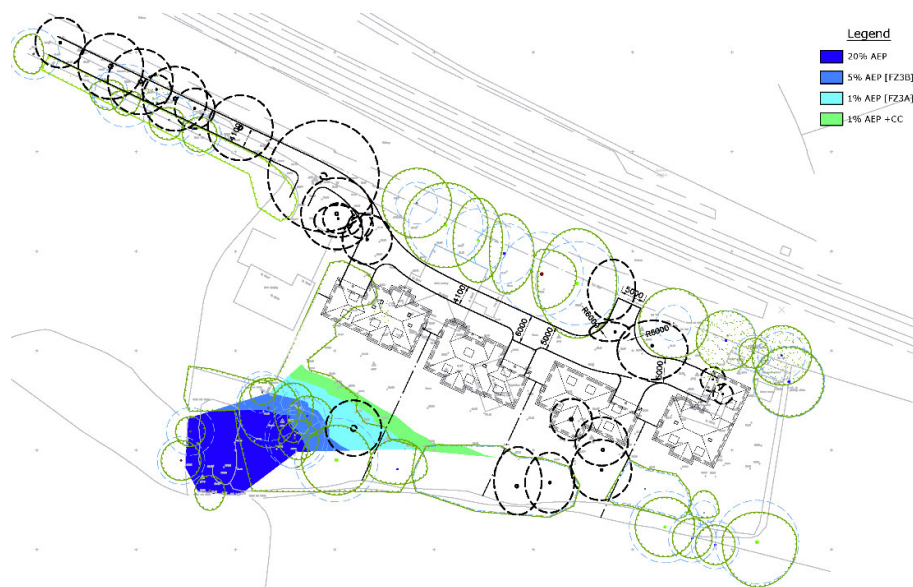


Figure 4.1 – Flood Extents based on Topographical Survey

4.1.4 As seen in Figure 4.1 above, the proposed buildings are not within any of the EA modelled flood extents. Therefore, they will not disrupt the flow of flood waters or affect storage volumes. Only the rear gardens of these properties will be affected by the flood waters of any flooding events.

4.1.5 From the results of the flood mapping using the flood level data provided by the EA, it can also be seen that the majority of the site falls outside of Flood zones 2 and 3, so it can therefore be concluded that the majority of the site is at a low risk of fluvial flooding.

Model	Emm Brook ESTRY 1D model, Jan07							
Node	Easting	Northing	1 in 5	1 in 20	1 in 50	1 in 100	1 in 100 +CC	1 in 1000
Emm2.74.1	481232.9	167760.8	50.16	50.38		50.64	50.80	
Emm2.73.1	481153.9	167828.3	49.83	50.02		50.37	50.60	
Emm2.72.1	481048.0	167864.4	49.76	49.98		50.36	50.60	
Emm2.71.1	480962.6	167895.1	49.71	49.93		50.33	50.58	
Emm2.69a.1	480932.5	167944.4	49.60	49.92		50.33	50.57	
Emm2.67.1	480914.7	167956.5	49.54	49.82		50.12	50.31	

Table 4.1 – Flood data for undefended scenario

4.1.6 A topographical survey of the site shows that there is a rise in levels from southwest to northeast, with the lowest level being in the southwest corner of 49.50m AOD, in the location of the pond and the highest being 54.72m AOD adjacent to the railway embankment. Therefore, the majority of the site is a significant height above the highest modelled flood level for the area.

4.2 Climate Change Allowances

4.2.1 The Environment Agency have published climate change allowances to be used in the preparation of Flood Risk Assessments. The allowance to be implemented for fluvial flooding it is based on the management catchment area, flood zone and site vulnerability. The site is located within the Wey and tributaries Management Catchment, as identified on the Department for Environment Food & Rural Affairs (DEFRA) climate change allowances website.

- 4.2.2 The site lies within all of Flood Zones 1, 2 and 3. Under Annex 3 of the NPPF the proposed development would be classed as: “Buildings used for residential uses” to be a “More Vulnerable” use.
- 4.2.3 The Flood Risk Assessments: Climate Change Allowances guidance, recommends that the Central Allowance for More Vulnerable uses in Floods Zones 2 and 3 should be used. The DEFRA website provides the Central Allowance to be applied to peak river flows for developments with a 100-year lifetime as 25%. The flood modelling provided by the EA included a scenario with a 25% increase in river flows, and this model will be used in our assessment.

5 IMPACT OF FLOODING

5.1 Impact on Flow of Flood Waters

- 5.1.1 As demonstrated above, the application site lies within Flood Zones 1, 2 and 3. The higher risk area, Flood Zone 3, is confined to the southwestern side of the site. The proposed buildings are to be located in Flood Zone 1 and will not affect the free flow of flood waters for an event with a probability of 1.0% plus 25% climate change allowance.

5.2 Impact on Flood Storage Volumes

- 5.2.1 The predicted flood waters with the climate change allowance factored in demonstrates that even in these conditions, the waters are not to reach the proposed dwellings, and therefore maintaining the existing ground levels to the rear of the properties will not impact flood storage volumes on the site.
- 5.2.2 This report has shown that the proposed buildings will be located outside of the 1% AEP +25% CC flooding extent so they will not reduce the volume of flood storage available on site.

5.3 Flood Impact on Development

- 5.3.1 As shown on the flood water visualisations produced using the EA's flood data, none of the flood water extents will reach the proposed houses. The highest level the flood water is expected to reach is 50.80m AOD, while the finished floor levels of the buildings be 52.50m AOD or greater.
- 5.3.2 This demonstrates that the proposed properties will not be subject to flooding from a 1.0% +25%CC event, so they should not suffer damage from flooding as it is likely that at least a 1.7m freeboard is provided between the highest estimated flood level and lowest floor level.

5.4 Safe Access & Egress

- 5.4.1 The proposed buildings will be located above the highest estimated flood level for an event with a probability of 1.0% +25 CC allowance. The access road to the proposed buildings will remain clear of flood waters as the levels identified on the topographical survey are greater than that of the maximum flood levels, so a safe and dry access can be provided at all times during a flood event.

5.5 Development Vulnerability Classification

- 5.5.1 The proposed development will comprise of the construction of 4 residential properties. Under Annex 3 of the NPPF and planning Practical Guidance, the development would be classified as a building used for dwelling houses and therefore considered to have a 'More Vulnerable' proposed use. This use class has been used when assessing the future impacts of climate change, and when undertaking the Sequential Test.

6 SEQUENTIAL TEST

- 6.1.1 The aim of the Sequential Test is to ensure that a sequential approach is used to steer new developments to areas with the lowest probability of flooding as set out in the NPPF and PPG.
- 6.1.2 Strategic Flood Risk Assessments (SFRA) refine information on the probability of flooding, taking other sources of flooding and the impacts of climate change into account. They provide the basis for applying the Sequential Test.
- 6.1.3 The proposed development is for residential use and therefore considered a 'More Vulnerable' use. An assessment of the EA's flood modelling has shown that the site falls within Flood Zones 1, 2 and 3 but the extent of Flood Zones 2 and 3 limited to the southwestern boundary. A sequential approach has been used when designing the layout of the development and the dwellings have been located in an area at less risk of flooding. As the proposed dwellings will be located above the estimated flood level for a 1 in 1000 year 0.1% (Flood Zone 1) the Sequential Test is satisfied.
- 6.1.4 Table 2 of the PPG reproduced as Table 6.1 below sets out the compatibility of proposed developments in relation to the Flood Zones. The proposed dwellings are considered a More Vulnerable use and are located in Flood Zone 1 which is considered a suitable use, and the exception test is not required.

Flood Zones	Flood Risk Vulnerability Classification				
	Essential infrastructure	Highly vulnerable	More vulnerable	Less vulnerable	Water compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test required	✓	✓	✓
Zone 3a †	Exception Test required †	X	Exception Test required	✓	✓
Zone 3b *	Exception Test required *	X	X	X	✓ *

Key:

✓ Exception test is not required

X Development should not be permitted

Table 6.1 – Flood Risk vulnerability Classification

7 EXISTING DRAINAGE

7.1 Foul Water Drainage

- 7.1.1 It is assumed that the foul water from the existing five-bedroom residential house is collected at its sources and transported down to a foul water sewer system in Finchampstead Road, existing manholes can be seen on the topographical survey.

7.2 Surface Water Drainage

- 7.2.1 It is assumed that the surface water collected from the site and the roof is transported and discharged into the nearby stream which is to the south of the site.

8 PROPOSED DRAINAGE

8.1 Proposed Foul Water Drainage

8.1.1 As per the existing house, the new residential houses will follow the same foul drainage regime of collecting the foul water from its sources and transporting the foul water into the existing foul water sewer route to connect into the Thames Water sewer which is expected to run along Finchampstead Road.

8.1.2 As stated above, this will aim to be done by using existing structures and pipes if possible, however a new system is to be constructed otherwise.

8.2 Proposed Surface Water Drainage

8.2.1 The Sustainable Drainage Systems (SuDS) hierarchy has been used to set the drainage strategy for the development. The SuDS considered as part of this assessment for the disposal of surface water runoff include rainwater harvesting, ground infiltration and discharging to watercourse.

8.2.2 Green / blue roofs were considered, but the proposed dwellings will all have pitched roofs, so these are not practical and have been discounted.

8.2.3 Rainwater harvesting was also considered, as a means of reusing surface water runoff within the dwellings. However, these systems require a separate network of pipes within the property, as well as tanks and pumps to store the rainwater and distribute it throughout. It was considered impractical to implement rainwater harvesting systems on the site due to site constraints and excessive costs for the development.

8.2.4 In addition, for these systems to be successfully implemented there must be sufficient demand for water reuse otherwise this may lead to water quality issues. Furthermore, rainwater harvesting tanks should not be included in the assessment of attenuation required to store runoff from a development as there is no guarantee that the tank will be sufficiently empty to receive another storm.

8.2.5 Should the rainwater harvesting tank be full at the start of the storm, it will not be able to receive any more runoff, therefore additional storage of a similar size would be required to cater for all storm events and the rainwater harvesting tank will provide no benefit in terms of attenuation. For those reasons, and the excessive cost of providing the system, this method has been discounted.

8.2.6 Next on the SuDS Hierarchy is use of infiltration techniques. Soil infiltration involves the surface runoff water being drained into the ground and absorbed by the soil. Due to the nature of the geology of the site being clay, infiltration is not considered to be viable, and therefore this has also been discounted.

8.2.7 Next on the list is discharging surface water to a river or watercourse. There is a watercourse which runs along the southern boundary of the site. It is therefore proposed to attenuate runoff on site and discharge to the watercourse at a restricted rate.

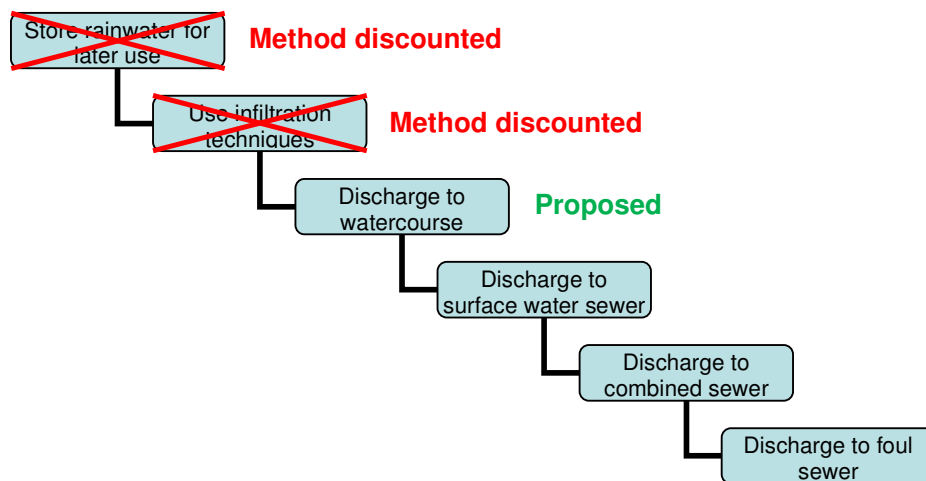


Figure 8.1 – SuDS Hierarchy

8.2.8 It is proposed to use permeable paving with 300mm gravel sub-base (30% void) along the access road to store runoff collected on the paved area and any runoff that flows into it, also filtering silt, suspended solids, and hydrocarbons. Water stored by the permeable paving is to be transported to the attenuation tank at a controlled rate via an orifice with 50mm diameter.

8.2.9 The attenuation tank has been sized at 20 x 7.5 x 0.4m (W x L x D) and is to be located towards the southern border of the site. This attenuation tank is to directly collect run off from the roofs and the permeable pavement, before discharging it into the nearby ditch to the south of the site via a HyrdroBrake at a controlled rate of 2.4 l/s with a head of 0.4 m to match the tank depth. The proposed layout for the drainage strategy is included in Appendix D as drawing 241778/DS/01.

8.2.10 Calculations have been completed to estimate the existing Greenfield runoff rates from the site and to set the proposed discharge rates. The results are tabulated below, and the full calculations are included within Appendix E. The results of the calculations show there will be between a 25% and 68% reduction in the peak discharge rate from the site when compared to the existing Greenfield runoff rate.

Return Period	Greenfield Run-off	Proposed Discharge	% Reduction
Q_{BAR}	2.4 l/s	-	-
1 in 1	2.0 l/s	1.5 l/s	25%
1 in 30	5.4 l/s	2.3 l/s	57%
1 in 100	7.6 l/s	2.4 l/s	68%
1 in 100 +40% CC	-	2.4 l/s	-

Table 8.1 – Existing and Proposed Rates

9 SURFACE WATER/ SUDS MAINTENANCE AND TREATMENT

9.1 SuDS Maintenance

- 9.1.1 Regularly inspecting the surface water drainage network for blockages and clearing unwanted debris / silt from the system should improve the performance of the surface water network and decrease the need for future repairs.
- 9.1.2 The level and frequency of maintenance required on site is dependent on the type of facility. The type of maintenance will fall into one of three categories "regular maintenance", "occasional maintenance" and "remedial maintenance".
- 9.1.3 Regular maintenance of the drainage and SuDS features will include, inspections, removal of litter / debris and sweeping of the surfaces. Occasional maintenance will include removal of sediment etc. and remedial maintenance may include structural repairs if required.
- 9.1.4 The drainage and SuDS elements after an initial inspection following construction should be inspected on a monthly basis for the first 12 months and after large storms, thereafter the following maintenance regime should be applied and adjusted if the 12-month monitoring process has identified any issues.
- 9.1.5 A management company will be set up to manage the development which will include the access roads and landscaped areas. The developer will be responsible for the drainage and SuDS until the management company is set up when the responsibility for the maintenance of SuDS will be transferred and they will ensure the system is funded adequately.
- 9.1.6 The appropriate health and safety equipment must be used when accessing manholes. Confined space certificates must be held by any personnel entering a manhole and the appropriate permits should be obtained.

Pipes and Manholes

9.1.7 For drainage pipes and manhole, the following maintenance is recommended.

Manhole / Pipe Maintenance Schedule		
	Required Action	Typical Frequency
Regular maintenance	Inspect for evidence of poor operation via water level in chambers. If required, take remedial action.	3-monthly, 48 hours after large storms.
	Check and remove large vegetation growth near pipe runs.	Monthly or as required
	Remove sediment from structures.	Annually or as required
Remedial Actions	Rod through poorly performing runs as initial remediation.	As required
	If continued poor performance jet and CCTV survey poorly performing runs.	As required
Monitoring	Inspect/check all inlets, outlets, to ensure that they are in good condition and operating as designed.	Annually
	Survey inside of pipe manholes for sediment build-up and remove if necessary	Every 5 years or as required

Table 9.1 – Manhole / Pipe Maintenance Schedule

Permeable Paving

9.1.8 For permeable paving areas, the following maintenance is recommended.

Permeable Paving Maintenance Schedule		
	Required Action	Typical Frequency
Regular maintenance	Remove debris and leaves etc.	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surfaces from adjacent impermeable areas as this area is most likely to collect the most sediment.
	Stabilise and mow contributing and adjacent areas	As required
Occasional maintenance	Removal of weeds	As required- once per year on less frequently used pavements
	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving	As required
Remedial Actions	Remedial work to any depressions, rutting etc	As required
	Rehabilitation of surface and upper substructure	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Inspect for evidence of poor operation and/or weed growth - if required, take remedial action.	Three-monthly, 48 hours after large storms in the first six months
	Inspect silt accumulation rates and establish appropriate frequencies for rehabilitation	Annually
	Monitor inspection chambers	Annually

Table 9.2 – Permeable Paving Maintenance Schedule

Attenuation Tanks

9.1.9 For the attenuation tanks, the following maintenance will be required.

Attenuation Tank Maintenance Schedule		
	Required Action	Typical Frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Annually
	Remove debris from the catchment surface (where it may cause risk to performance).	Monthly
	For systems where rainfall infiltrates in the tank from above, check surface of filter for blockage by sediment, algae or other matter, remove and replace surface infiltration medium as necessary	Annually
	Remove sediment from pre-treatment structures.	Annually or as required
Remedial Actions	Repair/rehabilitate inlets/outlets, overflows and vents.	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed.	Annually
	Survey inside of tanks for sediment build-up and remove if necessary	Every 5 years or as required

Table 9.3 – Attenuation Tank Maintenance

9.2 SuDS Treatment

9.2.1 As part of the CIRIA SuDS Manual C753, Section 26 provides guidance regarding methods for managing pollution risks from surface water runoff. Part of the assessment is to determine which land use classification the development falls under, Table 26.1 of the CIRIA Report C753 sets the approaches to water quality risk management. For this site the Simple Index Approach will be used.

9.2.2 Table 26.2 in C753 reproduced as Table 9.3, shows the potential hazard associated with different land uses the hazard indices. The development will consist of residential properties, it is concluded that the site should be classed within the sections shown in Table 9.3 below.

9.2.3 The roofs of the dwellings are considered to have a “very low” pollution hazard, generating 0.2 total suspended solids, 0.2 metals and 0.05 hydrocarbons. The access and parking areas are considered to have a “low” pollution hazard, generating 0.5 total suspended solids, 0.4 metals and 0.4 hydrocarbons.

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

Table 9.3 – CIRIA SuDS Manual C753 (Land use classifications)

9.2.4 The proposed development will incorporate permeable paving for storage and disposal of runoff from the site. Suitable treatment measures offered by SuDS features are set out in CIRA report.

9.2.5 Table 26.3 of C753 reproduced below as Table 9.4 sets out the mitigation indices provided by SuDS features for discharge to surface waters.

TABLE 26.3 Indicative SuDS mitigation indices for discharges to surface waters			
Type of SuDS component	Mitigation indices¹		
	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.		

Table 9.4 – CIRIA SuDS Manual C753 (Mitigation Indices to Surface Water)

9.2.6 The permeable paving will provide mitigation of 0.7 for total suspended solids, 0.6 for metals and 0.7 for hydrocarbons. These are all greater than the pollution hazard indices identified in Table 9.3 above for access roads etc.

10 SUMMARY AND CONCLUSION

- 10.1.1 The site is located off Finchampstead Road, Wokingham, RG40 2NS. The surrounding area contains open fields to the southeast, residential properties to the north and commercial/industrial use to the west.
- 10.1.2 The proposed development consists of the demolition of the existing property and outbuildings with the erection of 4 new five-bedroom detached houses. The ditch along the southern boundary is to be cleaned and landscaped to form a feature and boundary to the site.
- 10.1.3 The proposed buildings are not within any flood water extents, therefore will not disrupt the flow of flood waters or reduce storage volumes, and only the rear gardens of these properties will be affected by any flood waters.
- 10.1.4 The proposed development is for residential use and is therefore considered a 'More Vulnerable' use. An assessment of the EA's flood modelling has shown that the site falls within Flood Zones 1, 2 and 3 but the extent of Flood Zones 2 and 3 is limited to the southern boundary. A sequential approach has been used when designing the layout of the development and the dwellings have been located in an area at less risk of flooding. As the proposed dwellings will be located above the estimated flood level for a 1 in 1000 year 0.1% (Flood Zone 1) the Sequential Test is satisfied.
- 10.1.5 The foul water is to be collected from its sources and if possible, to use existing pipework to discharge foul water into the sewer which is presumed to run along Finchampstead Road, if this is not possible then a new system will be constructed.
- 10.1.6 Rainwater will be stored within the permeable paving with 300mm gravel sub-base (30% void) along the access road. This will then cascade into an attenuation tank along with runoff from the roofs, with a final discharge into the ditch along the southern boundary limited by a HydroBrake. This strategy will result in a reduction in peak flow rates of between 25% and 68% when compared to the existing Greenfield rate.

- 10.1.7 This FRA has demonstrated that the proposals will not have any impact on the current flooding in the area and that a suitable drainage strategy can be provided without increasing the risk of flooding, and we therefore see no reason why these proposals should be refused on the grounds of flooding or drainage.

APPENDIX A

2560-09 – Proposed Site Layout

Notes

All dimensions and levels on site are to be checked prior to commencement of work.

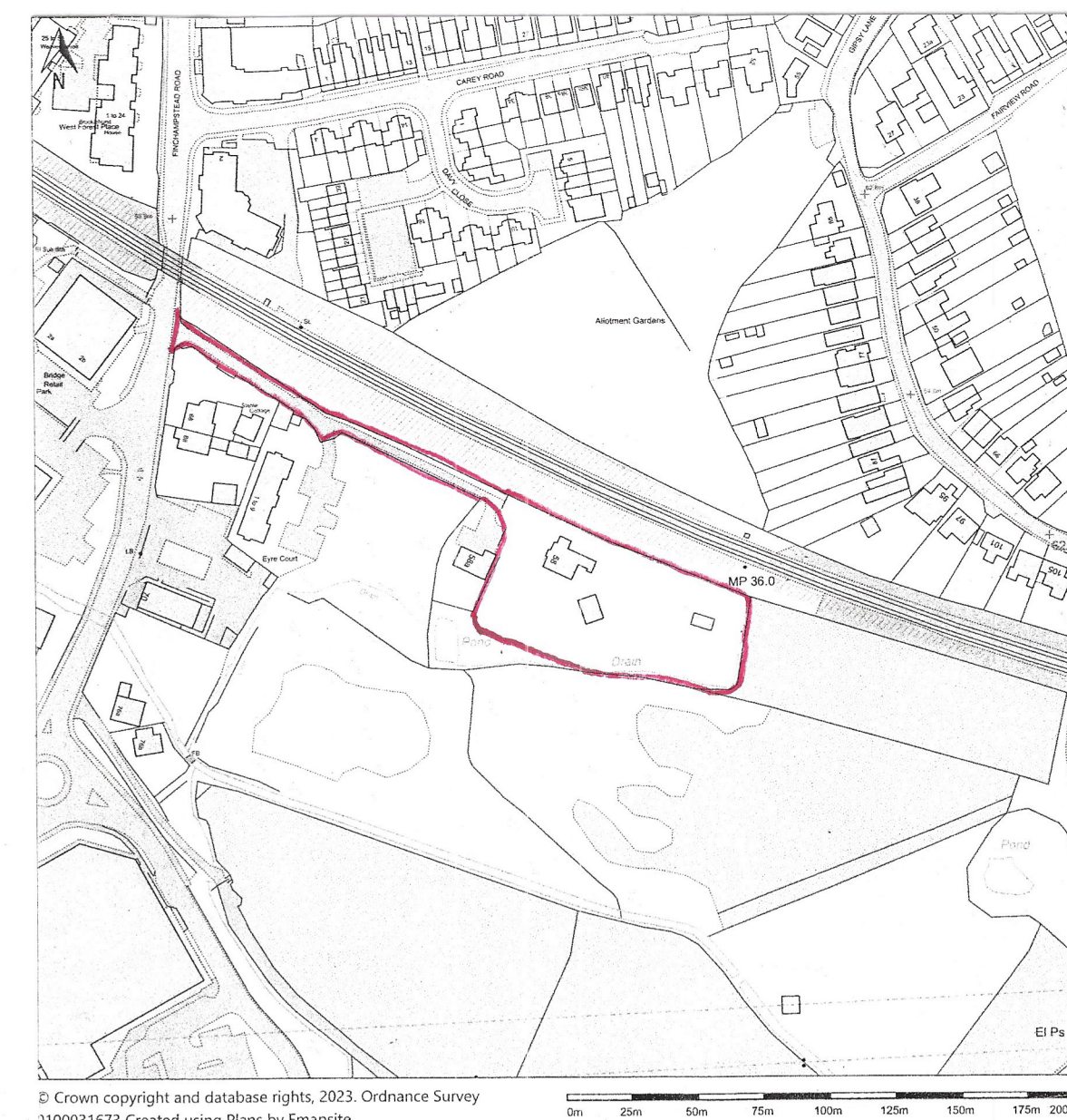
This drawing is the copyright of Paul Edwards Architecture

SITE AREA = 0.541 ha = 1.340 acres

Plot 1	5 bedroom detached house	gia = 287.25m
2	5 " " " "	= 312.45m
3	5 " " " "	= 316.45m
4	5 " " " "	= 325.15m

All dwellings to have double garages

▼ Denotes position of electric vehicle charging points to each dwelling



LOCATION PLAN 1:2500

- C : FENCES BETWEEN EACH PLOT REFERRED TO SHOW DIFFERENCE WHERE IN FLOOD ZONE 14.10.24.
- B : BIN COLLECTION POINT REPOSITIONED 26.08.24
- A : CAR PARKING SPACES SHOWN IN 26.07.24 FRONT OF GARAGES.

Project
Proposed detached houses
58 Finchampstead Road
WOKINGHAM
Berks

Client
Blueking Holdings Ltd

Drawing

SITE PLANS

Scale
As shown at A2 February 2024

Paul Edwards Architecture

12 Sandy Lane, Barkham, Wokingham, Berks RG41 4DB
 Tel: 01189772925 Mob: 07831837415 E-mail: paul@pauledwardsarchitecture.co.uk

Job 2560 Dwg.09C

SITE PLAN 1:500



APPENDIX B

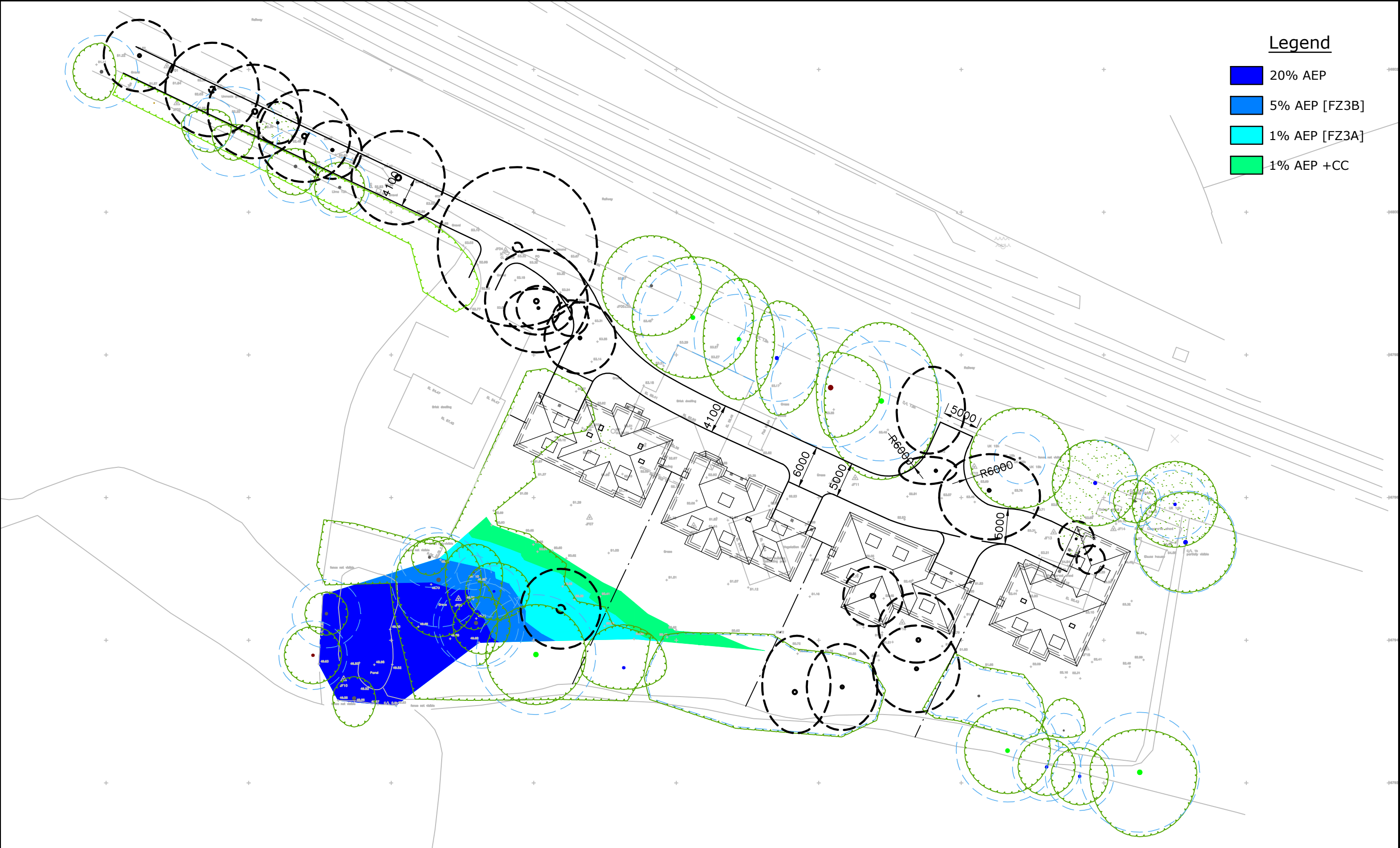
27123cv-01 – Topographical Survey

APPENDIX C

241778/FRA/01 – Emm Brook ESTRY 1D model, Jan07

241778/FRA/02 – Fluvial flood levels compared with topographical survey

241778/FRA/03 – Risk of Flooding from Surface Water



Legend

- 20% AEP
- 5% AEP [FZ3B]
- 1% AEP [FZ3A]
- 1% AEP + CC

Kingsley Davis

58 Finchampstead Road
Wokingham

Fluvial flood levels compared with topographical survey

LANMOR Consulting
Civil Engineers & Transport Planning

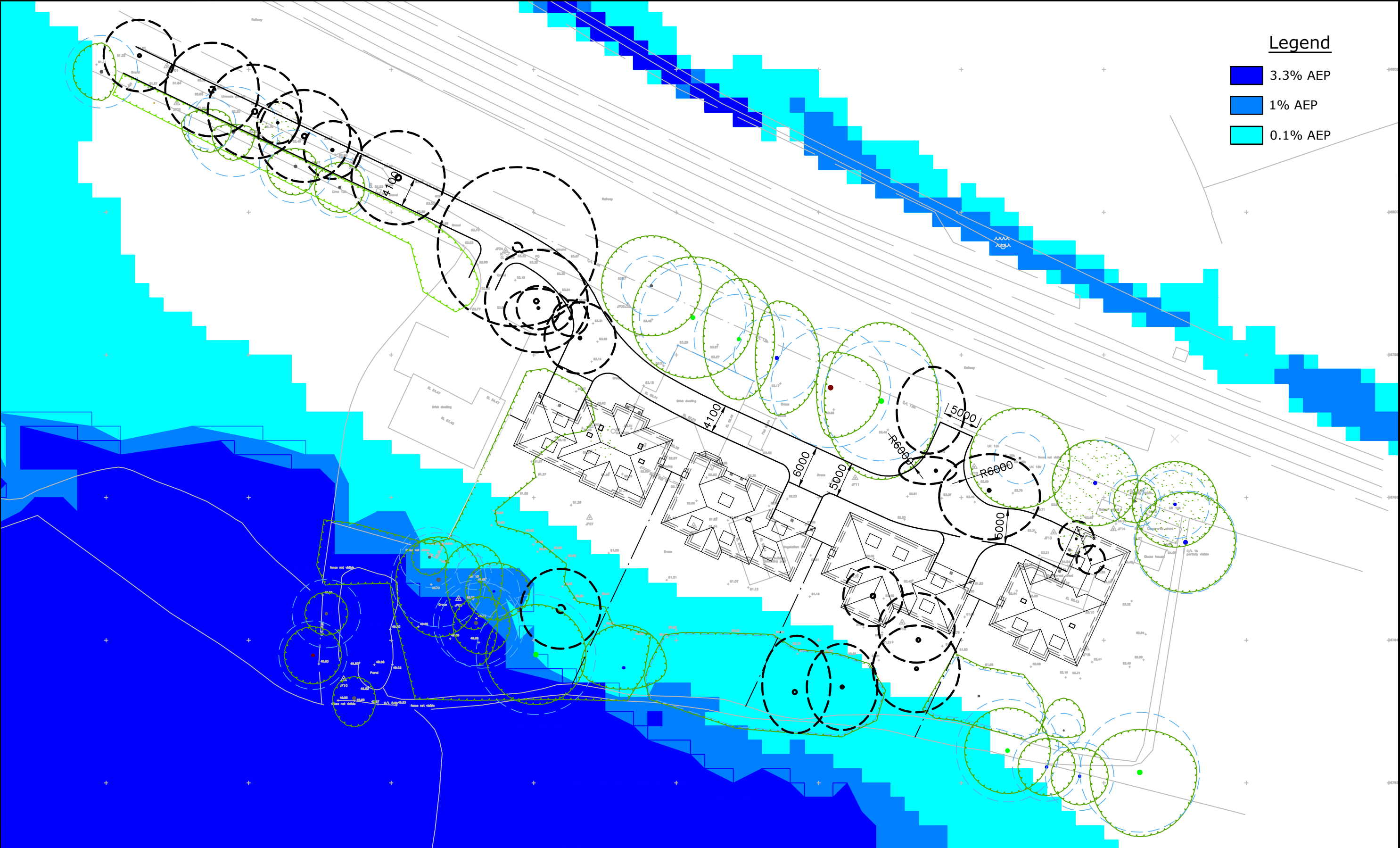
Thorogood House, 34 Tolworth Close, Surbiton, Surrey, KT6 7EW
Telephone: 0208 339 7899 Fax: 0208 339 7898
E-mail: info@lanmor.co.uk
www.lanmor.co.uk

SCALE 1:500

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DWG No. 241778/FRA/02 Rev A



Legend

- 3.3% AEP
- 1% AEP
- 0.1% AEP

Kingsley Davis

58 Finchampstead Road
Wokingham

Risk of Flooding from Surface Water

LANMOR Consulting
Civil Engineers & Transport Planning

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www.lanmor.co.uk

SCALE 1:500

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DWG No. 241778/FRA/03 Rev A

APPENDIX D

241778/DS/01 – Proposed Drainage Strategy



Kingsley Davis

58 Finchampstead Road
Wokingham

Drainage Strategy



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SCALE 1:500

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DWG No. 241778/DS/01 Rev A

APPENDIX E

Drainage Calculations

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Thorogood House 34 Tolworth Close Surbition Surrey KT6 7EW	58 Finchampstead Road Wokingham Berks	
Date April 2024 File	Designed by RS Checked by KBL	
XP Solutions	Source Control 2015.1	

ICP SUDS Mean Annual Flood

Input

Return Period (years) 100 SAAR (mm) 700 Urban 0.000
Area (ha) 0.541 Soil 0.450 Region Number Region 6

Results 1/s

QBAR Rural 2.4
QBAR Urban 2.4

Q100 years 7.6

Q1 year 2.0
Q30 years 5.4
Q100 years 7.6

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Thorogood House 34 Tolworth Close Surbition Surrey KT6 7EW	58 Finchampstead Road Wokingham Berks	
Date April 2024	Designed by RS	
File Cascade.casx	Checked by KBL	
XP Solutions		Source Control 2015.1

Cascade Summary of Results for PAVING.srcx

Upstream Outflow To Overflow To Structures

(None) TANK.srcx (None)

Half Drain Time : 42 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	52.605	0.305	0.0	2.8	2.8	8.1	Flood Risk
30 min Summer	52.643	0.343	0.0	2.9	2.9	10.1	Flood Risk
60 min Summer	52.663	0.363	0.0	3.0	3.0	11.1	Flood Risk
120 min Summer	52.659	0.359	0.0	3.0	3.0	10.9	Flood Risk
180 min Summer	52.642	0.342	0.0	2.9	2.9	10.0	Flood Risk
240 min Summer	52.622	0.322	0.0	2.8	2.8	9.0	Flood Risk
360 min Summer	52.587	0.287	0.0	2.7	2.7	7.1	Flood Risk
480 min Summer	52.557	0.257	0.0	2.5	2.5	5.7	Flood Risk
600 min Summer	52.531	0.231	0.0	2.4	2.4	4.6	Flood Risk
720 min Summer	52.508	0.208	0.0	2.2	2.2	3.8	Flood Risk
960 min Summer	52.472	0.172	0.0	2.0	2.0	2.6	O K
1440 min Summer	52.422	0.122	0.0	1.6	1.6	1.3	O K
2160 min Summer	52.383	0.083	0.0	1.3	1.3	0.6	O K
2880 min Summer	52.366	0.066	0.0	1.0	1.0	0.4	O K
4320 min Summer	52.353	0.053	0.0	0.7	0.7	0.2	O K
5760 min Summer	52.346	0.046	0.0	0.6	0.6	0.2	O K
7200 min Summer	52.341	0.041	0.0	0.5	0.5	0.1	O K
8640 min Summer	52.337	0.037	0.0	0.4	0.4	0.1	O K
10080 min Summer	52.334	0.034	0.0	0.4	0.4	0.1	O K
15 min Winter	52.629	0.329	0.0	2.9	2.9	9.3	Flood Risk
30 min Winter	52.675	0.375	0.0	3.1	3.1	11.7	Flood Risk
60 min Winter	52.694	0.394	0.0	3.2	3.2	12.7	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	127.583	0.0	9.6	17
30 min Summer	83.871	0.0	13.3	30
60 min Summer	52.595	0.0	17.1	46
120 min Summer	31.922	0.0	21.1	80
180 min Summer	23.544	0.0	23.5	114
240 min Summer	18.869	0.0	25.2	148
360 min Summer	13.701	0.0	27.5	212
480 min Summer	10.923	0.0	29.3	272
600 min Summer	9.157	0.0	30.7	332
720 min Summer	7.925	0.0	31.9	392
960 min Summer	6.304	0.0	33.8	510
1440 min Summer	4.560	0.0	36.5	740
2160 min Summer	3.293	0.0	39.2	1100
2880 min Summer	2.611	0.0	41.1	1464
4320 min Summer	1.880	0.0	43.6	2168
5760 min Summer	1.488	0.0	45.2	2888
7200 min Summer	1.240	0.0	46.3	3640
8640 min Summer	1.069	0.0	47.0	4384
10080 min Summer	0.942	0.0	47.5	4992
15 min Winter	127.583	0.0	11.0	17
30 min Winter	83.871	0.0	15.1	30
60 min Winter	52.595	0.0	19.3	48

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XP Solutions	Source Control 2015.1	

Cascade Summary of Results for PAVING.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
120 min Winter	52.683	0.383	0.0	3.1	3.1	12.1	Flood Risk
180 min Winter	52.656	0.356	0.0	3.0	3.0	10.7	Flood Risk
240 min Winter	52.627	0.327	0.0	2.9	2.9	9.2	Flood Risk
360 min Winter	52.577	0.277	0.0	2.6	2.6	6.6	Flood Risk
480 min Winter	52.535	0.235	0.0	2.4	2.4	4.8	Flood Risk
600 min Winter	52.500	0.200	0.0	2.2	2.2	3.5	Flood Risk
720 min Winter	52.472	0.172	0.0	2.0	2.0	2.6	O K
960 min Winter	52.430	0.130	0.0	1.7	1.7	1.5	O K
1440 min Winter	52.384	0.084	0.0	1.3	1.3	0.6	O K
2160 min Winter	52.362	0.062	0.0	0.9	0.9	0.3	O K
2880 min Winter	52.353	0.053	0.0	0.7	0.7	0.2	O K
4320 min Winter	52.343	0.043	0.0	0.5	0.5	0.2	O K
5760 min Winter	52.337	0.037	0.0	0.4	0.4	0.1	O K
7200 min Winter	52.333	0.033	0.0	0.3	0.3	0.1	O K
8640 min Winter	52.329	0.029	0.0	0.3	0.3	0.1	O K
10080 min Winter	52.328	0.028	0.0	0.3	0.3	0.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
120 min Winter	31.922	0.0	23.8	86
180 min Winter	23.544	0.0	26.5	122
240 min Winter	18.869	0.0	28.4	158
360 min Winter	13.701	0.0	31.1	222
480 min Winter	10.923	0.0	33.1	284
600 min Winter	9.157	0.0	34.6	342
720 min Winter	7.925	0.0	36.0	398
960 min Winter	6.304	0.0	38.1	512
1440 min Winter	4.560	0.0	41.2	738
2160 min Winter	3.293	0.0	44.3	1096
2880 min Winter	2.611	0.0	46.5	1460
4320 min Winter	1.880	0.0	49.5	2152
5760 min Winter	1.488	0.0	51.5	2928
7200 min Winter	1.240	0.0	52.8	3592
8640 min Winter	1.069	0.0	53.8	4304
10080 min Winter	0.942	0.0	54.5	4968

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XP Solutions		
Source Control 2015.1		

Cascade Rainfall Details for PAVING.srcx

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.600	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.048

Time (mins)		Area
From:	To:	(ha)
0	4	0.048

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XP Solutions	Source Control 2015.1	

Cascade Model Details for PAVING.srcx

Storage is Online Cover Level (m) 52.800

Complex Structure

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	40.0
Max Percolation (l/s)	55.6	Slope (1:X)	50.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	52.300	Cap Volume Depth (m)	0.300

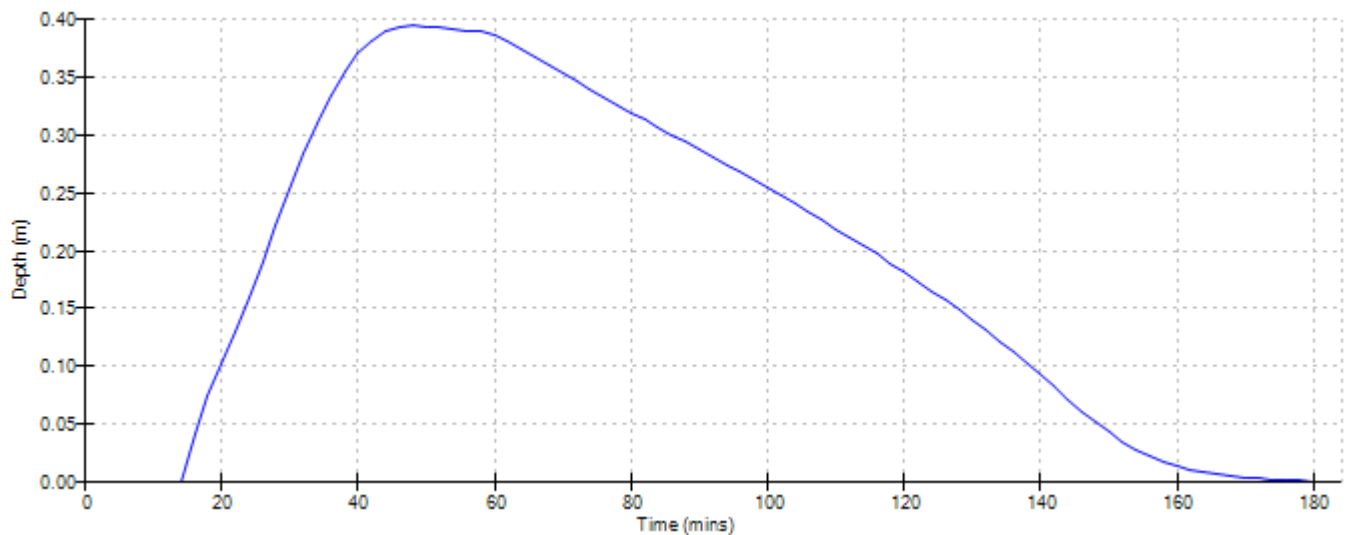
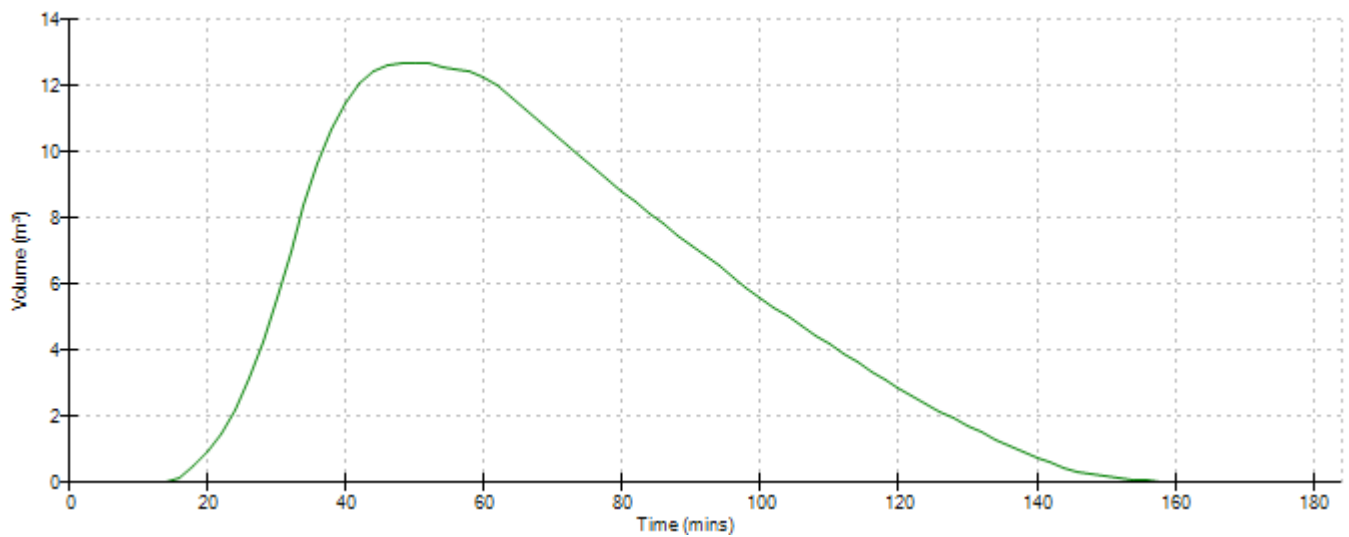
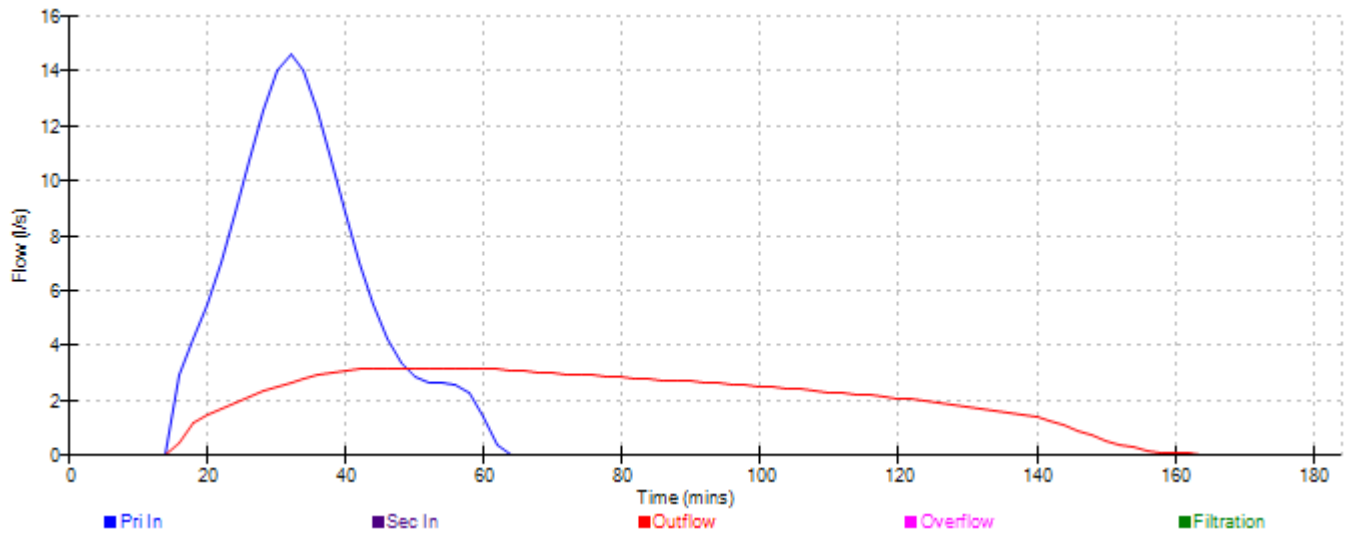
Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.1
Membrane Percolation (mm/hr)	1000	Length (m)	40.0
Max Percolation (l/s)	45.6	Slope (1:X)	80.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	52.300	Cap Volume Depth (m)	0.300

Orifice Outflow Control

Diameter (m) 0.050 Discharge Coefficient 0.600 Invert Level (m) 52.300

Cascade Event: 60 min Winter for PAVING.srcx



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XP Solutions	Source Control 2015.1	

Cascade Summary of Results for TANK.srcx

**Upstream Outflow To Overflow To
Structures**

PAVING.srcx (None) (None)

Half Drain Time : 202 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	49.805	0.145	0.0	2.3	2.3	20.7	O K
30 min Summer	49.853	0.193	0.0	2.3	2.3	27.5	O K
60 min Summer	49.906	0.246	0.0	2.4	2.4	35.0	O K
120 min Summer	49.959	0.299	0.0	2.4	2.4	42.6	O K
180 min Summer	49.987	0.327	0.0	2.4	2.4	46.6	O K
240 min Summer	49.998	0.338	0.0	2.4	2.4	48.2	O K
360 min Summer	49.991	0.331	0.0	2.4	2.4	47.2	O K
480 min Summer	49.980	0.320	0.0	2.4	2.4	45.7	O K
600 min Summer	49.968	0.308	0.0	2.4	2.4	43.9	O K
720 min Summer	49.955	0.295	0.0	2.4	2.4	42.0	O K
960 min Summer	49.926	0.266	0.0	2.4	2.4	37.9	O K
1440 min Summer	49.872	0.212	0.0	2.4	2.4	30.2	O K
2160 min Summer	49.812	0.152	0.0	2.3	2.3	21.7	O K
2880 min Summer	49.775	0.115	0.0	2.2	2.2	16.4	O K
4320 min Summer	49.743	0.083	0.0	1.8	1.8	11.9	O K
5760 min Summer	49.729	0.069	0.0	1.5	1.5	9.9	O K
7200 min Summer	49.721	0.061	0.0	1.3	1.3	8.7	O K
8640 min Summer	49.715	0.055	0.0	1.1	1.1	7.9	O K
10080 min Summer	49.711	0.051	0.0	1.0	1.0	7.3	O K
15 min Winter	49.823	0.163	0.0	2.3	2.3	23.3	O K
30 min Winter	49.878	0.218	0.0	2.4	2.4	31.1	O K
60 min Winter	49.938	0.278	0.0	2.4	2.4	39.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	127.583	0.0	29.0	45
30 min Summer	83.871	0.0	38.8	67
60 min Summer	52.595	0.0	49.5	98
120 min Summer	31.922	0.0	60.5	142
180 min Summer	23.544	0.0	67.2	184
240 min Summer	18.869	0.0	71.9	242
360 min Summer	13.701	0.0	78.4	306
480 min Summer	10.923	0.0	83.4	362
600 min Summer	9.157	0.0	87.4	420
720 min Summer	7.925	0.0	90.7	480
960 min Summer	6.304	0.0	96.2	604
1440 min Summer	4.560	0.0	104.2	848
2160 min Summer	3.293	0.0	112.8	1196
2880 min Summer	2.611	0.0	118.9	1532
4320 min Summer	1.880	0.0	127.5	2244
5760 min Summer	1.488	0.0	134.1	2944
7200 min Summer	1.240	0.0	138.8	3672
8640 min Summer	1.069	0.0	142.6	4408
10080 min Summer	0.942	0.0	145.6	5144
15 min Winter	127.583	0.0	32.7	50
30 min Winter	83.871	0.0	43.7	75
60 min Winter	52.595	0.0	55.7	108

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XP Solutions	Source Control 2015.1	

Cascade Summary of Results for TANK.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
120 min Winter	49.999	0.339	0.0	2.4	2.4	48.2	O K
180 min Winter	50.031	0.371	0.0	2.4	2.4	52.8	O K
240 min Winter	50.047	0.387	0.0	2.4	2.4	55.2	O K
360 min Winter	50.042	0.382	0.0	2.4	2.4	54.5	O K
480 min Winter	50.025	0.365	0.0	2.4	2.4	52.0	O K
600 min Winter	50.005	0.345	0.0	2.4	2.4	49.2	O K
720 min Winter	49.982	0.322	0.0	2.4	2.4	45.9	O K
960 min Winter	49.934	0.274	0.0	2.4	2.4	39.1	O K
1440 min Winter	49.853	0.193	0.0	2.3	2.3	27.5	O K
2160 min Winter	49.778	0.118	0.0	2.2	2.2	16.8	O K
2880 min Winter	49.748	0.088	0.0	1.9	1.9	12.6	O K
4320 min Winter	49.726	0.066	0.0	1.4	1.4	9.4	O K
5760 min Winter	49.716	0.056	0.0	1.1	1.1	7.9	O K
7200 min Winter	49.710	0.050	0.0	0.9	0.9	7.1	O K
8640 min Winter	49.705	0.045	0.0	0.8	0.8	6.4	O K
10080 min Winter	49.702	0.042	0.0	0.7	0.7	6.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
120 min Winter	31.922	0.0	68.1	154
180 min Winter	23.544	0.0	75.5	192
240 min Winter	18.869	0.0	80.8	240
360 min Winter	13.701	0.0	88.1	330
480 min Winter	10.923	0.0	93.7	382
600 min Winter	9.157	0.0	98.2	446
720 min Winter	7.925	0.0	101.9	510
960 min Winter	6.304	0.0	108.1	642
1440 min Winter	4.560	0.0	117.1	890
2160 min Winter	3.293	0.0	126.8	1216
2880 min Winter	2.611	0.0	133.7	1532
4320 min Winter	1.880	0.0	143.5	2248
5760 min Winter	1.488	0.0	150.9	2944
7200 min Winter	1.240	0.0	156.4	3664
8640 min Winter	1.069	0.0	160.9	4392
10080 min Winter	0.942	0.0	164.4	5152

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XP Solutions	Source Control 2015.1	

Cascade Rainfall Details for TANK.srcx

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.600	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.083

Time (mins)		Area
From:	To:	(ha)
0	4	0.083

Lanmor Consulting Ltd		Page 4
Thorogood House 34 Tolworth Close Surbition Surrey KT6 7EW	58 Finchampstead Road Wokingham Berks	
Date April 2024	Designed by RS	
File Cascade.casx	Checked by KBL	
XP Solutions	Source Control 2015.1	

Cascade Model Details for TANK.srcx

Storage is Online Cover Level (m) 50.410

Cellular Storage Structure

Invert Level (m) 49.660 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	150.0	150.0	0.400	150.0	172.0	0.401	0.0	172.0

Hydro-Brake Optimum® Outflow Control

Unit Reference MD-SHE-0076-2400-0800-2400
Design Head (m) 0.800
Design Flow (l/s) 2.4
Flush-Flo™ Calculated
Objective Minimise upstream storage
Diameter (mm) 76
Invert Level (m) 49.660
Minimum Outlet Pipe Diameter (mm) 100
Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	2.4	Kick-Flo®	0.507	1.9
Flush-Flo™	0.237	2.4	Mean Flow over Head Range	-	2.1

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake Optimum® as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.1	0.800	2.4	2.000	3.6	4.000	5.0	7.000	6.5
0.200	2.4	1.000	2.6	2.200	3.8	4.500	5.3	7.500	6.7
0.300	2.3	1.200	2.9	2.400	3.9	5.000	5.5	8.000	6.9
0.400	2.2	1.400	3.1	2.600	4.1	5.500	5.8	8.500	7.1
0.500	2.0	1.600	3.3	3.000	4.4	6.000	6.0	9.000	7.3
0.600	2.1	1.800	3.4	3.500	4.7	6.500	6.3	9.500	7.5

Cascade Event: 240 min Winter for TANK.srcx

