LANMOR Consulting

Civil Engineers & Transport Planners

Upper Culham Farm

Flood Risk Assessment & Drainage Strategy

May 2025

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Rev B

LANMOR Consulting

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1 INTRODUCTION

1.1 Scope

1.1.1 Lanmor Consulting has been commissioned to provide a Flood Risk Assessment & Drainage Strategy report for the proposed equestrian development at Upper Culham Farm, Upper Culham Lane, Upper Culham, Reading, RG10 8NR.

1.1.2 This report describes the sites existing condition, development proposals and implications of flooding on the site as described in the governments guidance document; National Planning Policy Framework (NPPF) and its technical guidance. This report will consider the following:

- Development proposals
- Sources of flooding and flood defences
- Flooding extents, depth and climate change predictions
- Impact of flooding on the development
- Dangers presented by flooding

1.1.3 This report has been prepared in accordance with the requirements of the governments National Planning Policy Framework (NPPF) and its planning practice guidance and will demonstrate that the proposed development will be safe and will not increase the risk of flooding in the surrounding area.

1.1.4 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.

1.2 Site Location

1.2.1 The site is situated off Culham Lane in a rural area of Henley-on Thames. The site currently stands as a farm area, thus is surrounded by vast Greenland (approx. 130 hectares). Within the greenspace, there stands various buildings which appear to be used for primarily agricultural purposes toward the western site boundary, directly off Culham Lane. Opposing Culham Lane are also some residential properties.

1.2.2 The closest watercourse to the site is the River Thames, which travels around the west and north of the site, approximately 1.3-1.5 km away. A site location plan has been provided in Figure 1.1 below.

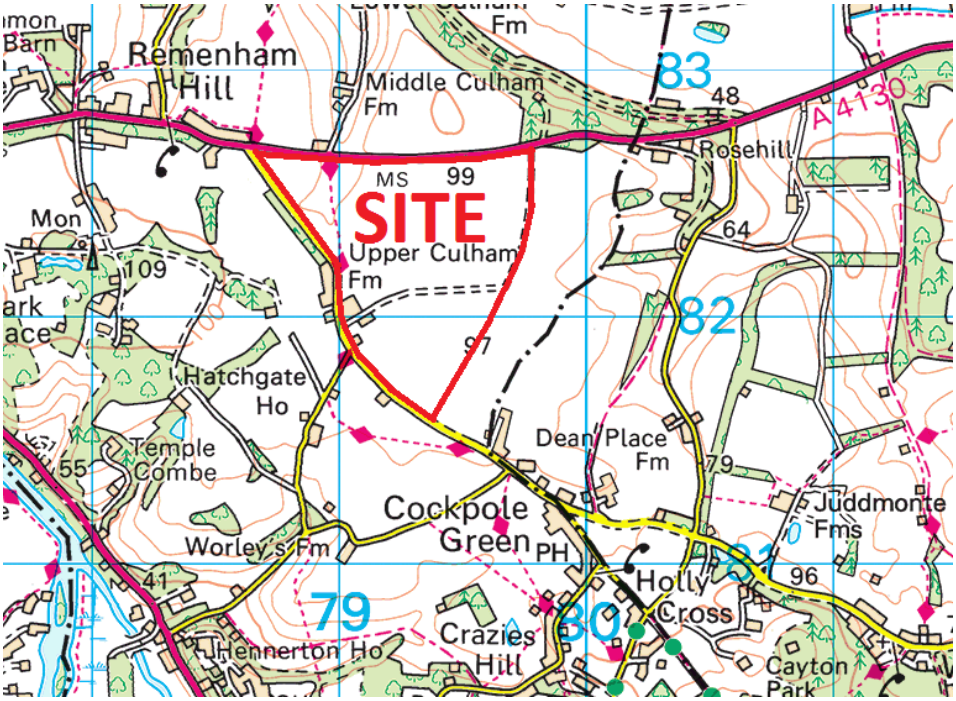


Figure 1.1 – Site Location

1.3 Development Proposals

1.3.1 The proposed development is for the construction of polo field, levelling of land for stick & ball and schooling fields, 3 x American barns, 2 x horse walkers, exercise track, irrigation pond, pump house, sand turnout corrals, horse rehabilitation pool, conversion of existing barn into staff day facilities, construction of pavilion and estate tracks, creation of new main access with entrance gates and open storage yard and associated works.

1.3.2 Most of the existing agricultural buildings toward the mid-western site boundary are to remain unaltered by the proposal, with one converted into staff day facilities. A copy of the Proposed Site Layout plan can be found in Appendix A.

1.4 Site Geology

1.4.1 The British Geological Survey (BGS) mapping indicates that the site sits upon the Bedrock formation of Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formations consisting of Chalk. The sites sedimentary bedrock was formed between 93.9 and 72.1 million years ago during the Cretaceous period.

1.4.2 The site also contains superficial deposits of clay with flints formation – consisting of clay, silt, sand and gravel. The sedimentary bedrock was said to be formed between 23.03 million and 11.8 thousand years ago during the Neogene and Quaternary periods.

1.5 Borehole Records

1.5.1 Borehole records were obtained via the use of BGS' GeoIndex to observe the sites geology in detail and determine the depth of which the chalk layers lay.

1.5.2 These records include a total of two boreholes that have been undertaken onsite in the past, one being situated toward the north eastern site boundary, known as SU78SE28; the other borehole being toward the southern boundary, known as SU78SE29.

1.5.3 Both boreholes present a similar soil structure, with borehole SE78SE28 hitting upper chalk layer at a depth of 2.5m, whilst borehole SU78SE29 strikes the same layer at a depth of 2m. Both recorded boreholes did not encounter groundwater at their respective depths.

1.5.4 Borehole records detailing these boreholes can be found within Appendix B of this report, and Figure 1.2 below shows the locations of the boreholes in relation to the site.

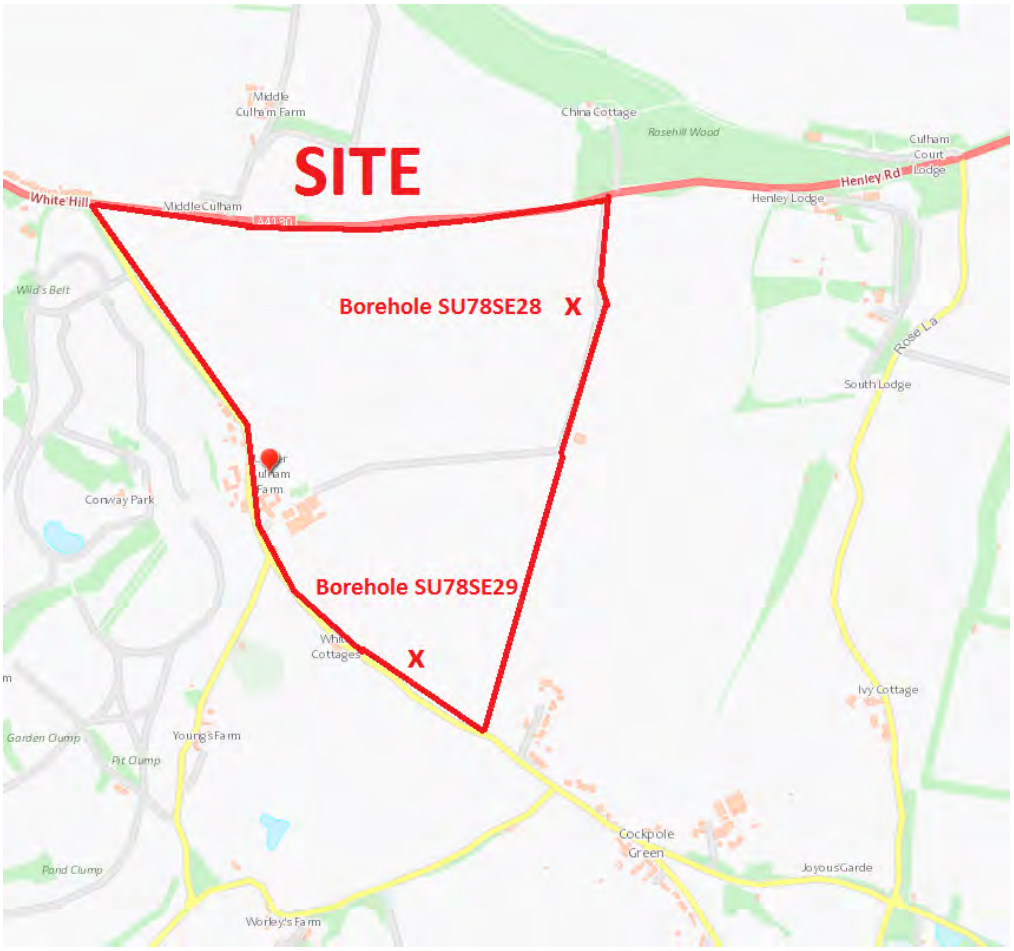


Figure 1.2 – BGS GeoIndex Borehole Records

2 SOURCES OF FLOODING

2.1 Fluvial / Tidal Flooding

2.1.1 Using the flood mapping services provided by the Environmental Agency (EA), which is considered to be an accurate measure of flood risk, we have determined the site is not at any substantial risk from flooding from fluvial or tidal forms.

2.1.2 The closest river to the site is the River Thames, as seen in Figure 2.1 we can see the river does not pose any flood risk to the site. This means that the area has a chance of flooding of less than 0.1% AEP, meaning flood risk from fluvial forms can be considered very low.

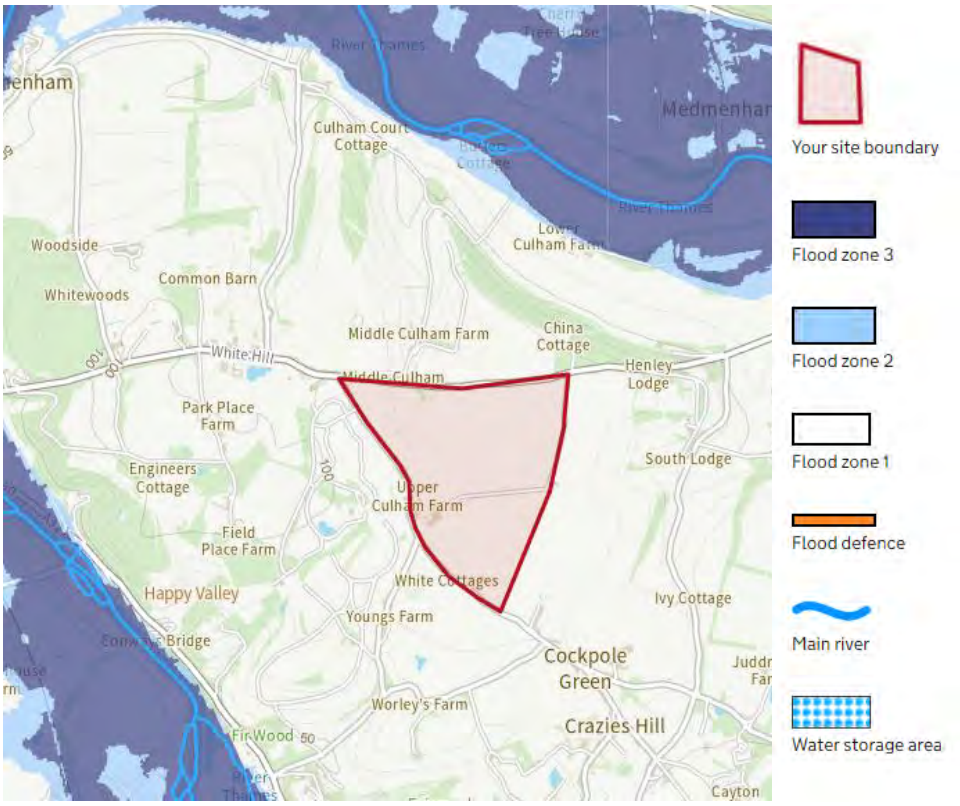


Figure 2.1 – Mapped Fluvial / Tidal Flood Risk

2.1.3 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 must 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).

2.1.4 The application site is shown to be within Flood Zone 1. This means that fluvial flood waters will not reach the site during a 1.0% (1 in 100) or a 0.1% (1 in 1000) year event.

2.1.5 The site is located a significant distance from Flood Zones 2 and 3, so even when future climate change allowances are considered, the site will still be some distance from the flooding and will not be affected by flood waters.

2.1.6 As the site is located in Flood Zone 1, it will not be affected by flood waters for the 1% or 0.1% AEP events, including allowances for climate change. Therefore, there will be no impact on the flow of flood water, flood storage volumes, or be affected by flood waters.

2.1.7 Also, a safe and dry access can be provided at all times during a storm event, and the Sequential Test is passed, as the development is located in an area at the lowest risk of flooding.

2.2 Surface Water Flood Risk

2.2.1 The EA also provides data which indicates a sites surface water flood risk, which can be seen below in Figure 2.2.

Figure 2.2 – Mapped Surface Water Flood Risk

2.2.2 In the above mapping, the site only contains 2 very small areas which presents a potential risk of surface water flooding where ground levels are at the lowest. Therefore, the risk of surface water flooding to the site is considered very low.

2.2.3 Consequently, we believe it is fair to say the general risk of surface water flooding to the site can be considered to be very low as a result of the majority of the site being permeably surfaced.

2.3 Groundwater Flooding

2.3.1 The local council's mapping indicates that the flood risk from groundwater is unlikely within the area of the site.

2.3.2 The borehole records discussed within section 1.2 of this report and shown in Appendix B demonstrate groundwater is not likely to be encountered at depths of 2 – 2.5m (above the chalk layer).

2.3.3 In order to further investigate the likelihood of groundwater flooding, as the sites bedrock geology consists of several chalk formations, Wokingham Borough Councils' (WBC) Local Flood Risk Management Strategy, April 2015 (LFRMS) was accessed. Mapping provided by WBC within the LFRMS under section D3, Historic Flooding, Groundwater flooding and represented as Figure 6 (provided as Figure 2.3 within this report) shows that the sites represented zone is within an area of very low susceptibility to groundwater flooding. This can be seen below within Figure 2.3.

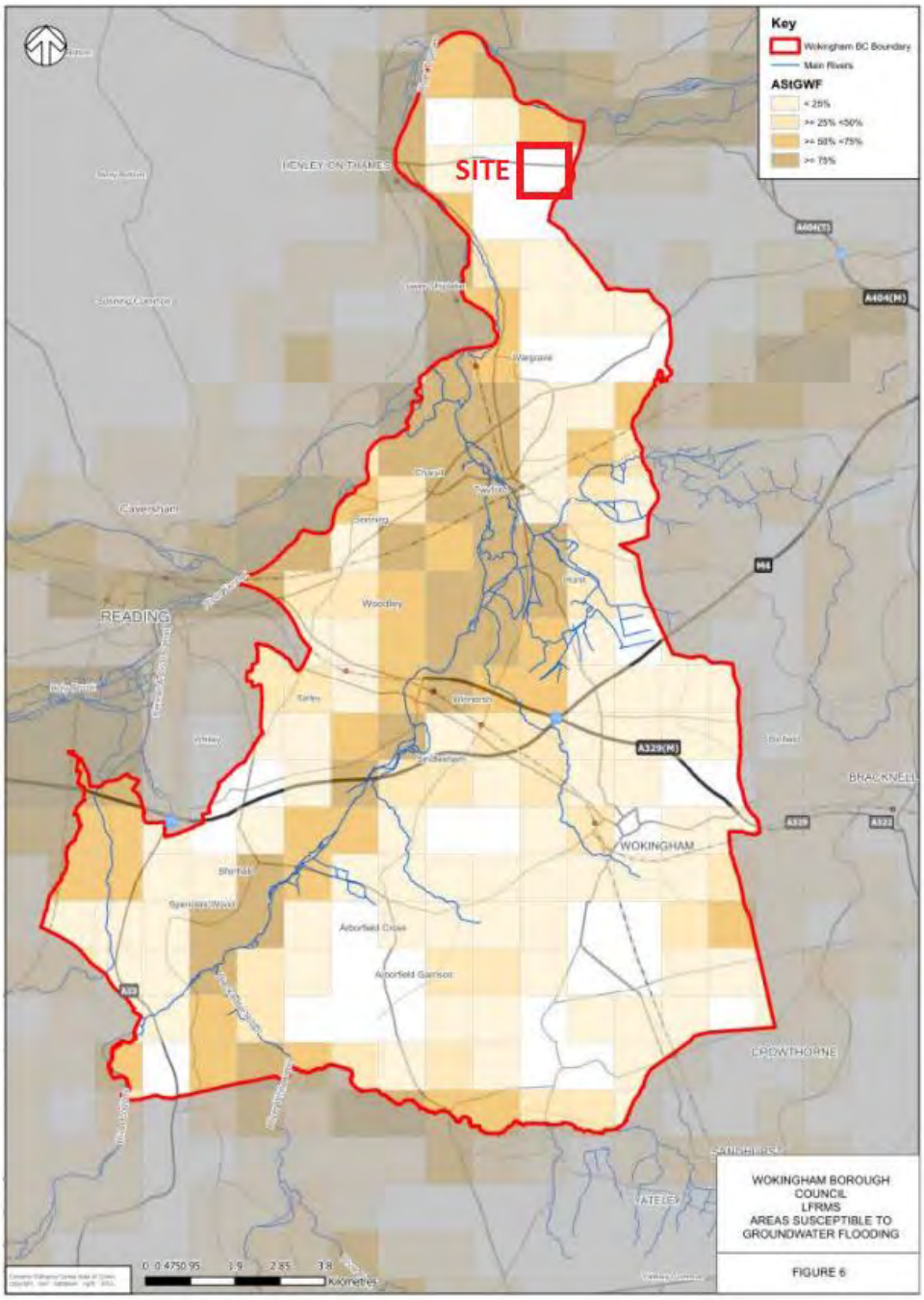


Figure 2.3 – Areas Susceptible to Groundwater Flooding

2.4 Reservoir Flooding

2.4.1 The EA mapping indicates that the flood risk from reservoir is unlikely within the area of the site.

3 DRAINAGE STRATEGY

3.1.1 It has been assumed that there are currently no positive drainage networks on site, and that all runoff discharges directly to ground. The proposed drainage strategy is to provide 3 independent networks, one for the foul wastewater, one for runoff from the building roofs, and one for runoff from the fields.

3.2 Foul Water Drainage

3.2.1 The proposed buildings will generate foul wastewater from toilets, sinks etc. Due to the rural location of the site, there is not a public foul water sewer in the vicinity that could be connected to. Therefore, the wastewater will be collected in an underground pipe network before being treated in a sewage treatment plant and discharged via a drainage field. The treatment plant and drainage field have been located downhill of the proposed buildings, in the corner of the field with the exercise track, in order to minimise risk to the users.

3.2.2 The sizes of the treatment plant and drainage field have been estimated based on the anticipated usage of each building as set out below.

American Barns

- WC – Up to 35 people working full time

Staff Day Facility

- Office – 1 person working full time

Pavilion

- Shower/WC – Up to 64 people 2 times/week

3.2.3 Given the above, there could be a maximum of 100 people on site during the practice matches. The anticipated usage could generate up to 6m^3 of foul effluent per day, based on 90 litres per day for day staff and 40 litres for match attendees. This is equivalent to 40 PE for residential use of 150 litres per day. The sewage treatment plant selected can serve up to 50 PE which gives flexibility, especially considering the matches are only twice per week. The drainage field has also been sized for 40 PE assuming a percolation value of 40 s/mm. The location of the sewage treatment plant and drainage field are shown on drawing 241842-DS-02 in Appendix C.

3.3 Surface Water Drainage

3.3.1 Sustainable Drainage Strategy (SuDS) were considered as part of this assessment for disposal of surface water runoff from the development. The site is to contain three respective fields and various buildings. These large fields will allow for any rainwater to be reused in irrigating the grounds. The fields will use filter drains to direct any intercepted flows toward an irrigation pond for reuse.

3.3.2 The site proposal also includes the erection of 3 no. American barns toward the mid-western site boundary. The storage of rainwater for later use via rainwater harvesting system was considered excessive for this building. This would require the implementation of tanks and pumps to store the rainwater, thus we deemed that it would be economically inefficient as the barn is to only hold equestrian animals/facilities and will not have sufficient water demand.

3.3.3 The American style barns will also have sloped roofs, and a green or blue roof is therefore not possible, so intercepted rainfall from the roof is to be collected and transported into soakaways which will then discharge into the soil.

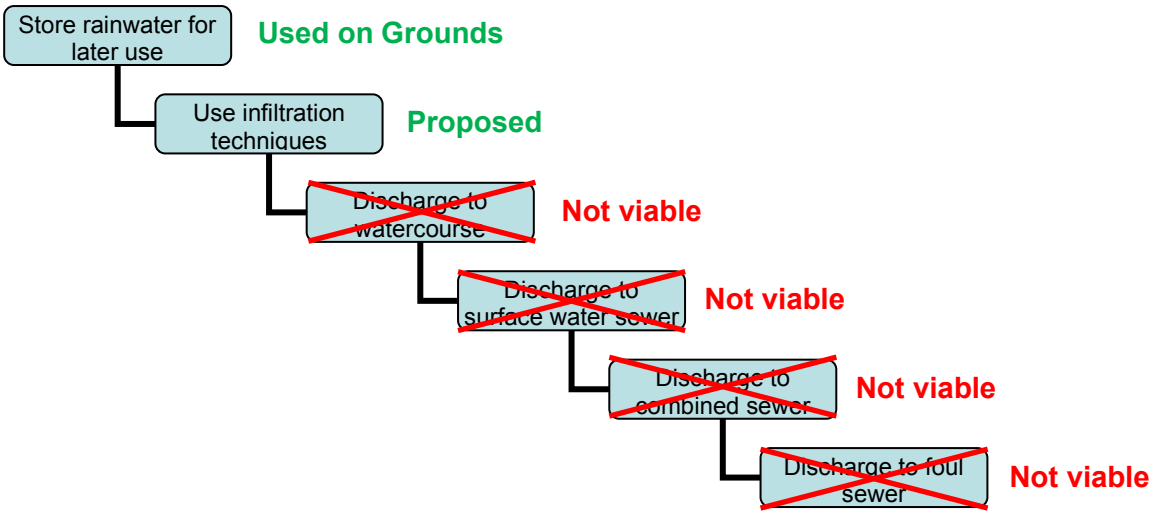


Figure 3.1 – SuDS hierarchy

3.3.4 For the 3 fields, a series of filter drains and pipes will be provided to collect and transport excess water towards the irrigation pond at the south of the site. The pond will be formed with one large basin and an overflow area. The basin will be lined to prevent water draining away into the ground, but the overflow area will not be lined. Once the main pond is full water will overflow into the secondary pond and drain away into the ground. The main pond is 5m deep with a total volume of 76,776.96m^3 and the secondary pond is 3m deep with a total volume of 17,242.94m^3.

3.3.5 The filter drains have been designed as 80mm diameter perforated pipes at 5m spacing, so will only collect some of the rainfall, with the remainder draining to ground. Calculations have been run for various scenarios depending on the assumed proportion of runoff that enters the filter drains.

% Impermeable	POND 1		POND 2	
	Depth of Water	% Capacity	Depth of Water	% Capacity
30%	0.905	14%	1.597	37%
70%	1.983	34%	2.880	93%
100%	2.718	48%	Flood	Flood

Table 3.1 – Pond Calculations (1 in 100 +CC)

3.3.6 The calculations show that the main pond has more than sufficient capacity to hold the full runoff from the 1 in 100 year storm event plus 40% allowance for climate change. In fact, it can even hold the volume of runoff assuming all the rainfall enters the filter drains (100% impermeability) twice over, which of course would not happen as much of the rainfall would drain into the ground.

3.3.7 Further calculations have been completed assuming that the first pond is full, and all the runoff overflows into the second pond. These results show that assuming that 30%, or event 70% of the rainfall enters the filter drains, the pond has sufficient capacity to discharge the runoff to ground without flooding. Only the 100% impermeable scenario (which is not realistic) results in flooding.

3.3.8 The drainage of the American Barns is to be contained within a separate pipe network which transports all rainwater from the roof into 3 soakaways, one for each barn, which have been located within the exercise track well away from the buildings. These soakaways have been sized at 1.5m wide x 60m long x 1.2m deep to accommodate the storage capacity required for a rainfall storm event of 1 in 100 years with the allowance of a 40% climate change increase.

3.3.9 The proposed drainage strategy drawings can be found in Appendix C and the calculations are provided in Appendix D.

4 SUDS MITIGATION

4.1.1 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 proposed development falls under, Table 26.1 of the report sets the approaches to water quality risk management. For this site the Simple Index Approach will be used.

4.1.2 Table 26.2 in C753 reproduced as Table 4.1 below, shows the potential hazards associated with different land uses and the hazard indices. The development will consist of a barn roof, it is concluded that the site should be classed within the sections shown in Table 4.1 below.

4.1.3 The roof of the equestrian building is considered to have a "low" pollution hazard, generating 0.3 total suspended solids, 0.2 metals and 0.05 hydrocarbons. The grounds are considered to have a "very low" pollution hazard as there will be negligible vehicular access.

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 4.1 – CIRIA SuDS Manual C753 (Land use classifications)

4.1.4 The barn roof is considered to have a “low” level of pollution, and the runoff will be discharged to ground via a soakaway. Catchpits will be provided in the inlets to the soakaway, capturing any silt or other debris in the runoff. This mitigation is considered sufficient for the proposals given the minimal level of pollution in the water.

5 SUDS MANAGEMENT AND MAINTAINENCE

5.1.1 Regular inspection of 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. In the event of blockages, high pressure water jets can be used to clear the gullies and pipes to ensure they are functioning correctly, this should be undertaken by certified trained professionals.

5.1.2 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'.

5.1.3 Regular Maintenance of the drainage and SuDS features could 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 and infiltration reconditioning if required.

5.1.4 The drainage 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.

5.1.5 The following maintenance regime is recommended for the SuDS features in the development and should be adjusted suit site requirements flowing the initial inspections if required.

Inspection, Manhole, Catchpit Chambers and Pipes

5.1.6 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.

5.1.7 Pipes are intended to be the main conveyance across the development. They are intended to be dry except for during rainfall events. These have been designed to be self-cleaning where possible for smaller diameter pipes, and for larger diameters the risk is reduced due to the overall pipe size.

5.1.8 For the Inspection, Manhole, Catchpit Chambers and Pipes, the following maintenance will be required.

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 5.1 – Manhole, Catchpit and Pipes Maintenance

Drainage Channels and Gullies

5.1.9 For the Inspection, drainage channel and gullies, the following maintenance will be required.

Channel and Gully Maintenance Schedule		
	Required Action	**Typical Frequency**
Regular maintenance	Litter and debris removal	Monthly or as required
	Check and remove large vegetation growth near channel runs	Monthly or as required
	Inspect for evidence of poor operation and/or weed growth. If required, take remedial action. Inspect silt accumulation rates and establish appropriate brushing frequencies. Silt can also be caused by adjacent landscaping areas which should be reprofiled to provide a flat area or berm adjacent to the paving	3-monthly, 48 hours after large storms
Remedial Actions	Inspect access/outlet boxes and rod through poorly performing channels and outlets as initial remediation.	As required
Monitoring	Inspect/check all inlets, outlets, to ensure that they are in good condition and operating as designed.	Annually
	Survey inside of gullies for sediment build-up and remove if necessary	Every year or as required

Table 5.2 – Channel and Gully Maintenance

Soakaways

5.1.10 For the soakaways, the following maintenance is recommended.

Soakaway Maintenance Schedule		
	Required Action	Typical Frequency
Regular maintenance	Inspect for sediment debris in pre-treatment components and floor of inspection tube / chamber and inside soakaway	Annually
	Cleaning of gutters and any filters on downpipes	Annually (or as required based on inspections)
	Trimming any roots that may be causing blockages	Annually (or as required)
Occasional maintenance	Remove sediment and debris from pre-treatment components and floor of inspection tube / chamber and inside soakaway	As required, based on inspections
Remedial Actions	Reconstruct soakaway and/or replace or clean void fill, if performance deteriorates or failure occurs	As required
	Replacement of clogged geotextile (will require reconstruction of soakaway)	As required
Monitoring	Inspect silt traps and note rate of sediment accumulation	Monthly in the first year and then annually
	Check soakaway to ensure emptying is occurring	Annually

Table 5.3 – Soakaway Maintenance

Ponds and Wetlands

5.1.11 For ponds and wetlands, the following maintenance is recommended.

Ponds and Wetlands Maintenance Schedule		
	Required Action	**Typical Frequency**
Regular maintenance	Remove litter and debris	Monthly (or as required)
	Cut the grass – public area	Monthly (During growing season)
	Cute the meadow grass	Half yearly (spring, before nesting season, and autumn)
	Inspect marginal and bankside vegetation and remove nuisance plants (for first 3 years)	Monthly (at start, then as require)
	Inspect inlets, outlets, banksides, structures, pipework etc for evidence of blockage and/or physical damage	Monthly
	Inspect water body for signs of poor water quality	Monthly (May-October)
	Inspect silt accumulation rates in any forebay and in main body of the pond and establish appropriate removal frequencies; undertake contamination testing once some build-up has occurred, to inform management and disposal	Half Early
	Check any mechanical devices, eg penstocks	Half early
	Hand cut submerged and emergent aquatic plants (at minimum of 1.0m above pond and base; include max 25% of pond surface)	Annually
	Remove 25% of bank vegetation from water's edge to a minimum of 1m above water level	Annually
	Tidy all dead growth (scrub clearance) before start of growing season (note: tree maintenance is usually part of overall landscape management contract)	Annually
	Remove sediment from any forebay	Every 1-5, or as required
	Remove sediment and planting from one quadrant of the main body of ponds	Every 5 years, or as required

Remedial Actions	Remove sediment from the main body of big ponds when pool volume is reduced by 20%	With effective pre-treatment, this will only be required rarely, e.g every 25-50 years
Monitoring	Repair erosion or other damage	As required
	Replant, where necessary	As required
	Aerate pond when signs of eutrophication are detected	As required
	Realign rip-rap or repair other damage	As required
	Repair/rehabilitate inlets outlets and overflows	As required

Table 5.4 – Pond and Wetland Maintenance

6 SUMMARY & CONCLUSION

6.1.1 This report has been prepared in accordance with the requirements of the governments National Planning Policy Framework (NPPF) and its planning practice guidance and has demonstrated that the proposed development will be safe and will not increase the risk of flooding in the surrounding area.

6.1.2 The site is situated off Culham Lane in a rural area of Henley-on Thames. The site currently stands as a farm area, thus is surrounded by vast Greenland (approx. 130 hectares). Within the greenspace, there stands buildings which are primarily used for agricultural purposes, toward the western site boundary, directly off Culham Lane. Opposing Culham Lane are also some residential properties.

6.1.3 Geology records indicate that the site sits upon the Bedrock formation of Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formations consisting of Chalk. Therefore, the use of infiltration techniques will be viable for the discharge of runoff.

6.1.4 Historical boreholes on-site present a similar soil structure to one another, with borehole SE78SE28 hitting upper chalk layer at a depth of 2.5m, whilst borehole SU78SE29 strikes the same layer at a depth of 2m. Both recorded boreholes did not encounter groundwater at their respective depths.

6.1.5 For the 3 proposed fields, a series of filter drains and pipes will be provided to collect and transport rainwater to the main irrigation pond. This pond is of sufficient size to hold the runoff from a number of consecutive storm events. In addition, there is a secondary pond to drain overflow into the ground.

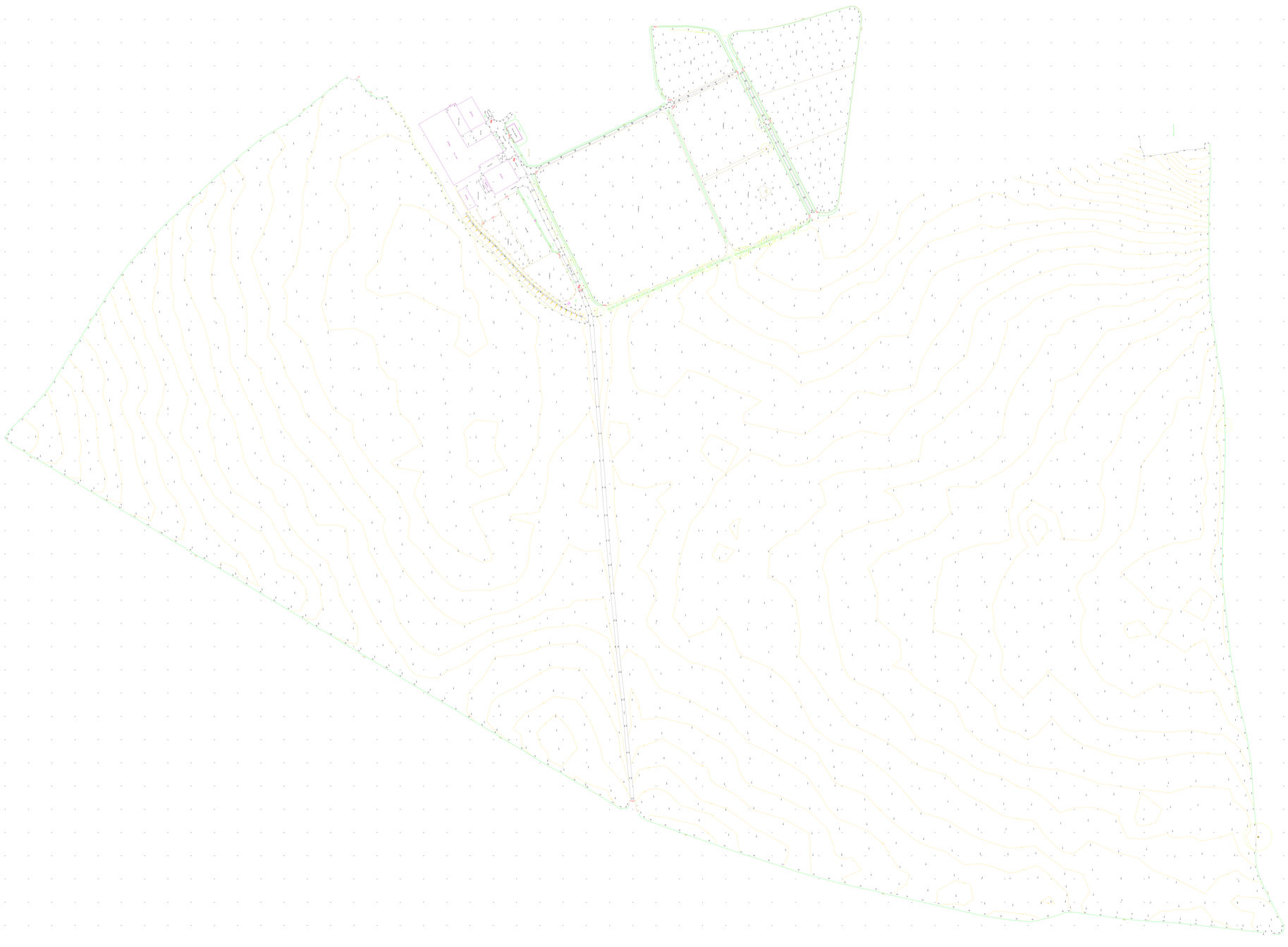
6.1.6 The American barns are to have a separate pipe network to drain rainwater from the roofs into a soakaway. These soakaways have been sized at 1.5m wide x 60m long x 1.2m deep to accommodate the storage capacity required for a rainfall storm event of 1 in 100 years with the allowance of a 40% climate change.

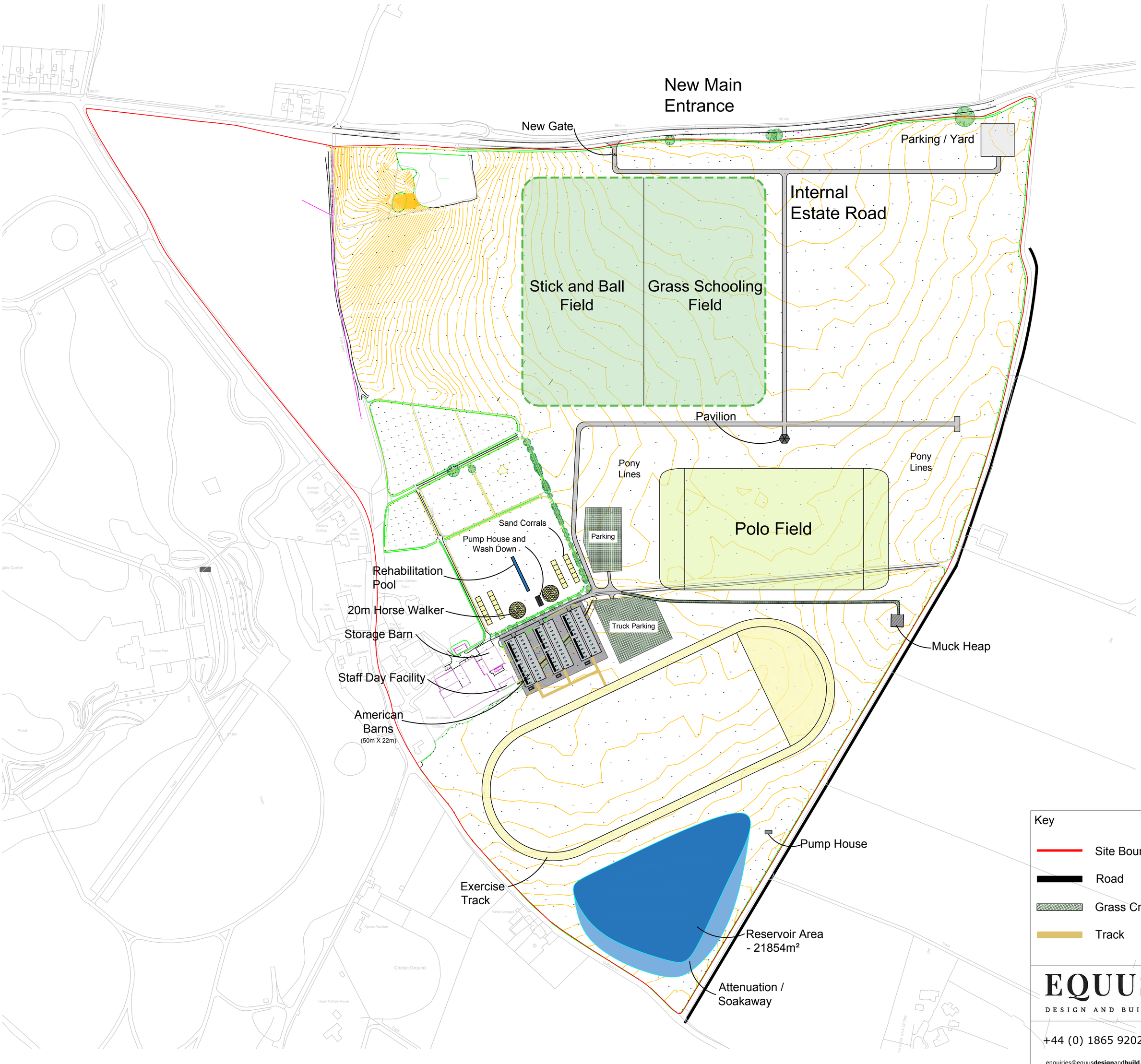
6.1.7 As demonstrated, the site is at very low risk of flooding and a suitable drainage strategy can be provided. Therefore, we see no reason to refuse this planning application on the grounds of flooding or drainage.

APPENDIX A

Topographical Survey

Upper Culham Farm – Proposed Site Layout





Proposed Layout
Upper Culham Farm
Henley
RG10 8NR

Proposed Site Layout

Scale 1:2500 (when printed at A1)

1:2500

50m 0 50m 100m 150m 200m 250m

EQUUS
DESIGN AND BUILD

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Proposed Development

Upper Culham Farm

Client	
Site	Upper Culham Farm
	Henley, RG10 8NR
Phone	

- All dimensions in millimeters. All dimensions and levels to be checked by contractor prior to commencing work.

- Assume drawings not to scale, use figured dimensions. Do not scale from drawings.

- Work done shall confirm to the issued drawings and specifications. No changes to be made unless by prior consultation with Deverson Design & Equus Works.

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Client approved, no further changes

(sign) .....

(date) .....

Project No		
Drawing Title	Proposed Site Layout	
Drawing No		
Pages		
Drawn	AD	April 2025
Review		
Leader		
Stage		
Scale	1:2500 (A1)	
Paper	A1	

NORTH

APPENDIX B

Borehole Records

SU 78 SE 28 7971 8245 Near Rosehill Wood, east of Remenham Hill

Surface level (+ 97.2 m) + 319 ft
Water not struck
Shell and auger (modified) 6 in (152 mm) diameter

Waste 1.5 m (5.0 ft)
Bedrock 1.0 m+ (3.5 ft+)

LOG

Geological Classification	Lithology	Thickness m	Thickness ft	Depth m	Depth ft
	Soil	0.3	(1.0)	0.3	(1.0)
Clay-with-flints	Clay, brown, silty, with large subangular to rounded flints	0.5	(1.5)	0.8	(2.5)
	Clay, light brown and grey, silty, with pebbles of flint and chalk	0.7	(2.5)	1.5	(5.0)
Upper Chalk	Chalk, with flints	1.0+	(3.5+)	2.5	(8.0)

SU 78 SE 29 7936 8162 Near Goulders Cottages, Cockpole Green

Surface level (+ 96.6 m) + 307 ft
Water not struck
Shell and auger (modified) 6 in (152 mm) diameter
January 1973

Waste 1.3 m (4.5 ft)
Bedrock 0.7 m+ (2.5 ft+)

LOG

Geological Classification	Lithology	Thickness m	Thickness ft	Depth m	Depth ft
	Soil	0.3	(1.0)	0.3	(1.0)
Clay-with-flints	Clay, brown, with fine to medium pebbles of sub-angular to subrounded flint and some chalk	0.3	(1.0)	0.6	(2.0)
	Clay, chalky, yellowish brown with abundant fine to medium pebbles of chalk and some flint	0.7	(2.5)	1.3	(4.5)
Upper Chalk	Chalk, with flints	0.7+	(2.5+)	2.0	(6.5)

Contact BGS: ngdc@bgs.ac.uk

SU 78 SE 28 7971 8245 Near Rosehill Wood, east of Remenham Hill

Surface level (+ 97.2 m) + 319 ft
Water not struck
Shell and auger (modified) 6 in (152 mm) diameter

Waste 1.5 m (5.0 ft)
Bedrock 1.0 m+ (3.5 ft+)

LOG

Geological Classification	Lithology	Thickness m	Thickness ft	Depth m	Depth ft
	Soil	0.3	(1.0)	0.3	(1.0)
Clay-with-flints	Clay, brown, silty, with large subangular to rounded flints	0.5	(1.5)	0.8	(2.5)
	Clay, light brown and grey, silty, with pebbles of flint and chalk	0.7	(2.5)	1.5	(5.0)
Upper Chalk	Chalk, with flints	1.0+	(3.5+)	2.5	(8.0)

SU 78 SE 29 7936 8162 Near Goulders Cottages, Cockpole Green

Surface level (+ 96.6 m) + 307 ft
Water not struck
Shell and auger (modified) 6 in (152 mm) diameter
January 1973

Waste 1.3 m (4.5 ft)
Bedrock 0.7 m+ (2.5 ft+)

LOG

Geological Classification	Lithology	Thickness m	Thickness ft	Depth m	Depth ft
	Soil	0.3	(1.0)	0.3	(1.0)
Clay-with-flints	Clay, brown, with fine to medium pebbles of sub-angular to subrounded flint and some chalk	0.3	(1.0)	0.6	(2.0)
	Clay, chalky, yellowish brown with abundant fine to medium pebbles of chalk and some flint	0.7	(2.5)	1.3	(4.5)
Upper Chalk	Chalk, with flints	0.7+	(2.5+)	2.0	(6.5)

APPENDIX C

E25-004-005 P01 – Drainage Design

241842-DS-02 – Proposed Drainage Strategy

Parking / Yard

Gas Pipeline
Indicative Location

Parking

Truck Parking

Muck Heap

Exercise Track

Reservoir Base = 89.000m

Storage Level = 93.500m
Storage Volume = 67298m³

Top of Bank = 94.000m

3m Wide Plateau 94.000m

Attenuation Base = 91.000m

Storage Level = 93.500m
Storage Volume = 12775m³

1:3 Batter Slopes

NOTES:

1. REFER TO WRITTEN SPECIFICATION AND DRAWINGS LISTED THEREIN.

2. DO NOT SCALE FROM THIS DRAWING. ALL DIMENSIONS TO BE CHECKED ON SITE. DO NOT MAKE ASSUMPTIONS.

LEGEND

- 80MM Ø LATERALS @ 5M INTERVALS
- 160MM Ø PLDP
- 225MM Ø PERFORATED TW
- 225MM Ø SOLID TW
- 375MM Ø SOLID TW
- SAND SLITS @ 2M INTERVALS

EXISTING LEVELS
- MAJOR CONTOURS - 1M INTERVALS
- MINOR CONTOURS - 25CM INTERVALS
- 1:3 FILL SLOPE
- 1:3 CUT SLOPE
- POLO FIELD
- EXERCISE TRACK
- GAS PIPE LINE (INDICATIVE LOCATION)
- ROAD - 5M WIDE
- MAINTENANCE TRACK - 3M WIDE
- ATTENUATION POND
- PAVILION

P1 06/05/25	RELEASED FOR COMMENT

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TITLE
DRAINAGE DESIGN

CLIENT
D S EQUINE

SITE
UPPER CULHAM FARM,
HENLEY, RG10 8NR.

WHITE HORSE CONTRACTORS
CONSTRUCTED WITH INTEGRITY

THE SLATTER GROUP

Tel: 01865 736272
www.whitehorsecontractors.co.uk

DR. NO. (ORIGINAL RETAINED BY WHC LTD)	REV
E25-004-005	P01

SCALE	DRAWN	CHECKED
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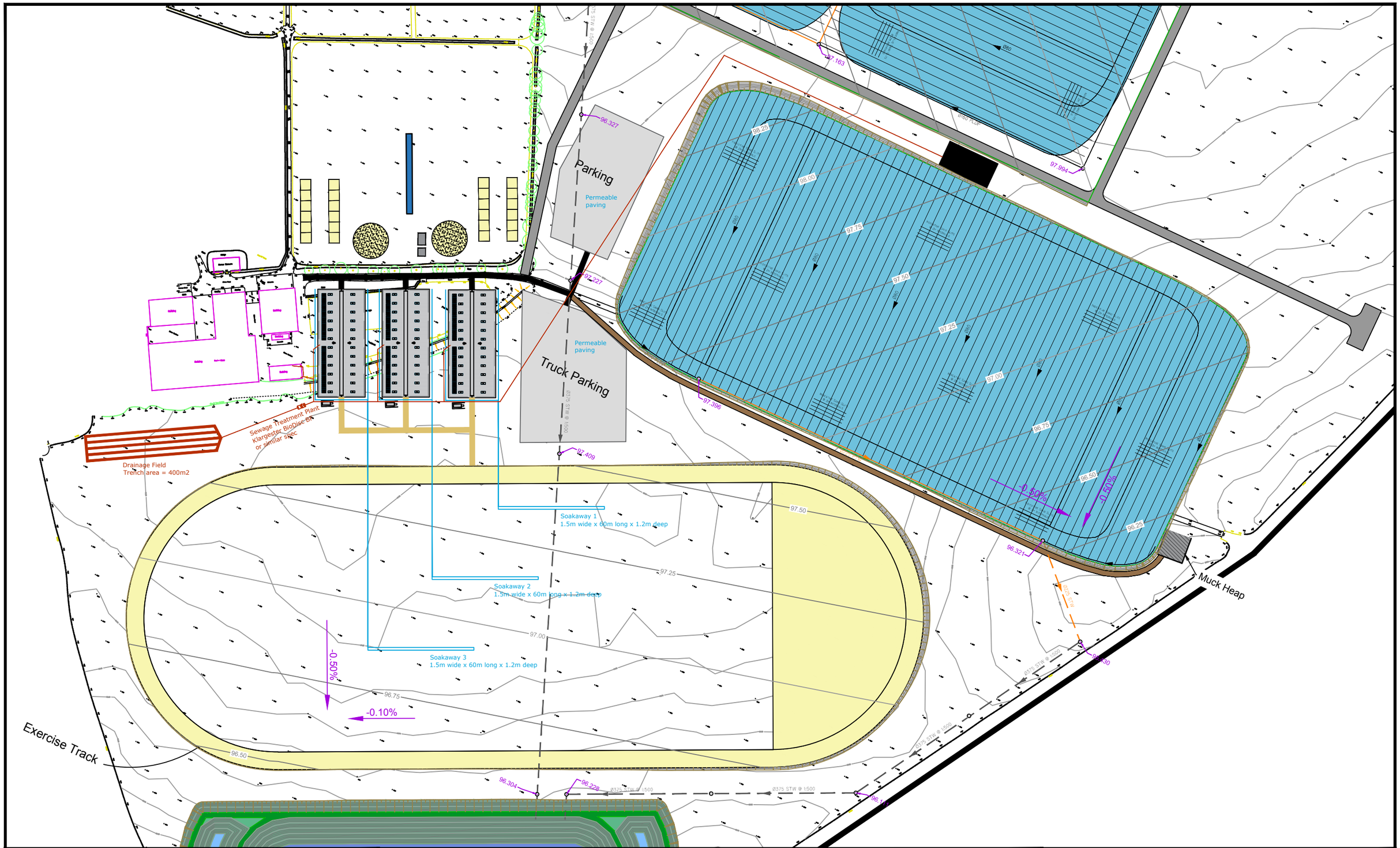

Mr Sarkis Gabrelian

Upper Culham Farm
Henley

Proposed Drainage Strategy

SCALE	DRAWN BY	PRJ No.	DWG No.
1:2000	RS	241842	241842-DS-02 Rev A

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

APPENDIX D

MicroDrainage Calculations

Summary of Results for 100 year Return Period (+40%)

Outflow is too low. Design is unsatisfactory.

Storm Event	Max Level (m)	Max Depth (m)	Max Overflow (l/s)	Max Volume (m³)	Status
15 min Summer	89.175	0.175	0.0	2045.4	O K
30 min Summer	89.228	0.228	0.0	2685.8	O K
60 min Summer	89.285	0.285	0.0	3358.6	O K
120 min Summer	89.343	0.343	0.0	4056.1	O K
180 min Summer	89.377	0.377	0.0	4468.0	O K
240 min Summer	89.400	0.400	0.0	4756.2	O K
360 min Summer	89.435	0.435	0.0	5182.3	O K
480 min Summer	89.462	0.462	0.0	5506.3	O K
600 min Summer	89.483	0.483	0.0	5767.1	O K
720 min Summer	89.501	0.501	0.0	5986.7	O K
960 min Summer	89.530	0.530	0.0	6345.5	O K
1440 min Summer	89.573	0.573	0.0	6877.4	O K
2160 min Summer	89.618	0.618	0.0	7441.4	O K
2880 min Summer	89.652	0.652	0.0	7861.5	O K
4320 min Summer	89.701	0.701	0.0	8482.4	O K
5760 min Summer	89.738	0.738	0.0	8943.7	O K
7200 min Summer	89.767	0.767	0.0	9313.5	O K
8640 min Summer	89.791	0.791	0.0	9623.6	O K
10080 min Summer	89.812	0.812	0.0	9891.4	O K
15 min Winter	89.195	0.195	0.0	2290.8	O K
30 min Winter	89.255	0.255	0.0	3008.1	O K
60 min Winter	89.318	0.318	0.0	3761.6	O K
120 min Winter	89.383	0.383	0.0	4542.8	O K
180 min Winter	89.421	0.421	0.0	5004.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	138.153	0.0	0.0	19
30 min Summer	90.705	0.0	0.0	34
60 min Summer	56.713	0.0	0.0	64
120 min Summer	34.246	0.0	0.0	124
180 min Summer	25.149	0.0	0.0	184
240 min Summer	20.078	0.0	0.0	244
360 min Summer	14.585	0.0	0.0	364
480 min Summer	11.622	0.0	0.0	484
600 min Summer	9.738	0.0	0.0	604
720 min Summer	8.424	0.0	0.0	724
960 min Summer	6.697	0.0	0.0	964
1440 min Summer	4.839	0.0	0.0	1444
2160 min Summer	3.490	0.0	0.0	2164
2880 min Summer	2.766	0.0	0.0	2884
4320 min Summer	1.989	0.0	0.0	4324
5760 min Summer	1.573	0.0	0.0	5768
7200 min Summer	1.311	0.0	0.0	7208
8640 min Summer	1.129	0.0	0.0	8648
10080 min Summer	0.994	0.0	0.0	10088
15 min Winter	138.153	0.0	0.0	19
30 min Winter	90.705	0.0	0.0	34
60 min Winter	56.713	0.0	0.0	64
120 min Winter	34.246	0.0	0.0	124
180 min Winter	25.149	0.0	0.0	184

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Overflow (l/s)	Max Volume (m³)	Status
240 min Winter	89.447	0.447	0.0	5326.9	O K
360 min Winter	89.486	0.486	0.0	5804.2	O K
480 min Winter	89.515	0.515	0.0	6167.0	O K
600 min Winter	89.539	0.539	0.0	6459.2	O K
720 min Winter	89.559	0.559	0.0	6705.1	O K
960 min Winter	89.591	0.591	0.0	7106.9	O K
1440 min Winter	89.639	0.639	0.0	7702.7	O K
2160 min Winter	89.689	0.689	0.0	8334.4	O K
2880 min Winter	89.727	0.727	0.0	8804.9	O K
4320 min Winter	89.782	0.782	0.0	9500.3	O K
5760 min Winter	89.822	0.822	0.0	10016.9	O K
7200 min Winter	89.855	0.855	0.0	10431.1	O K
8640 min Winter	89.882	0.882	0.0	10778.5	O K
10080 min Winter	89.905	0.905	0.0	11078.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
240 min Winter	20.078	0.0	0.0	244
360 min Winter	14.585	0.0	0.0	364
480 min Winter	11.622	0.0	0.0	484
600 min Winter	9.738	0.0	0.0	604
720 min Winter	8.424	0.0	0.0	724
960 min Winter	6.697	0.0	0.0	964
1440 min Winter	4.839	0.0	0.0	1444
2160 min Winter	3.490	0.0	0.0	2164
2880 min Winter	2.766	0.0	0.0	2884
4320 min Winter	1.989	0.0	0.0	4324
5760 min Winter	1.573	0.0	0.0	5768
7200 min Winter	1.311	0.0	0.0	7208
8640 min Winter	1.129	0.0	0.0	8648
10080 min Winter	0.994	0.0	0.0	10088

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Rainfall Details

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)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 7.896

Time (mins) From:	To:	Area (ha)
0	4	7.896

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Model Details

Storage is Online Cover Level (m) 96.000

Tank or Pond Structure

Invert Level (m) 89.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	11596.5	1.500	13778.2	3.000	16080.4	4.500	18503.1	6.000	21055.4
0.250	11951.7	1.750	14153.6	3.250	16475.8	4.750	18918.5	6.250	21493.8
0.500	12310.3	2.000	14532.2	3.500	16874.6	5.000	19337.4	6.500	21935.8
0.750	12672.3	2.250	14914.3	3.750	17276.7	5.250	19761.5	6.750	22381.3
1.000	13037.6	2.500	15299.6	4.000	17682.1	5.500	20189.2	7.000	22830.4
1.250	13406.2	2.750	15688.3	4.250	18090.9	5.750	20620.5		

Weir Overflow Control

Discharge Coef 0.544 Width (m) 359.375 Invert Level (m) 94.000

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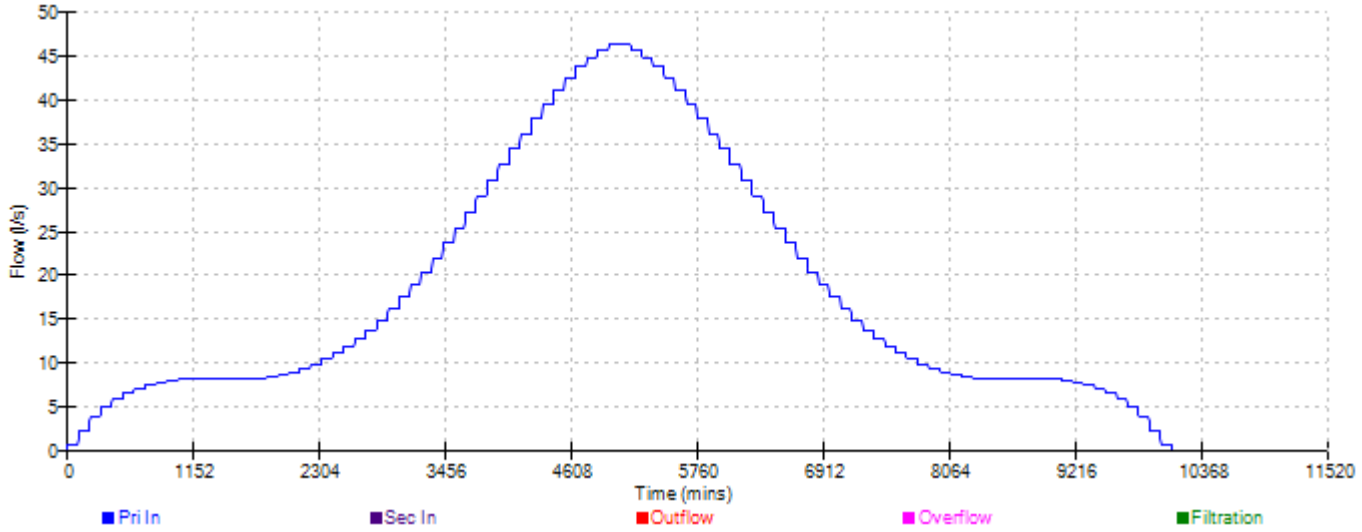
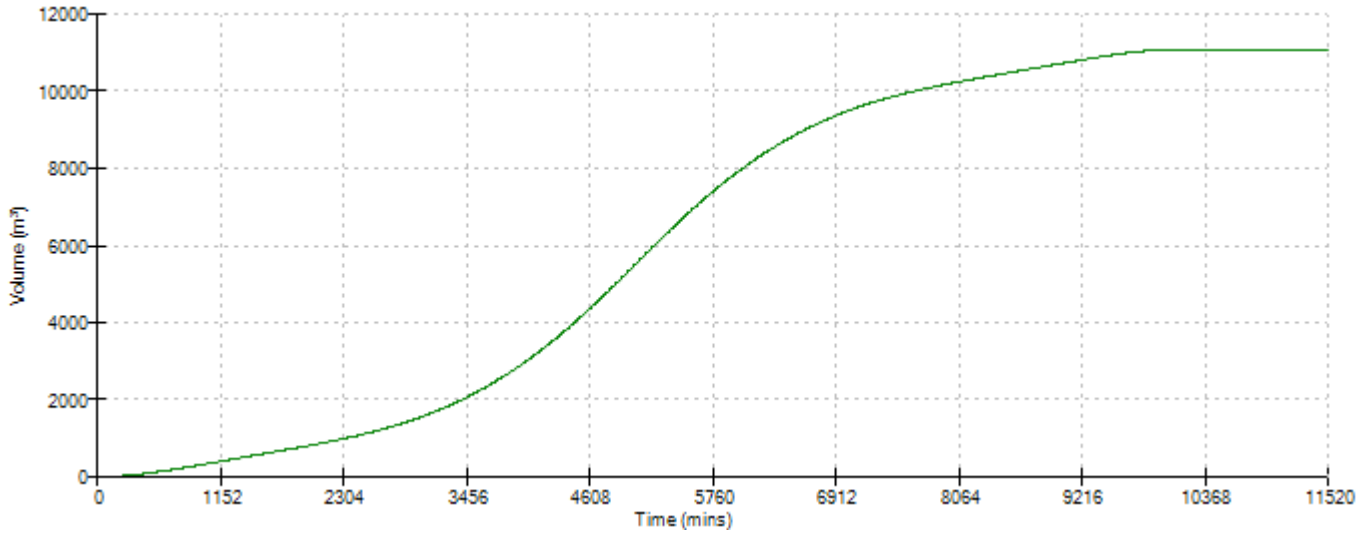
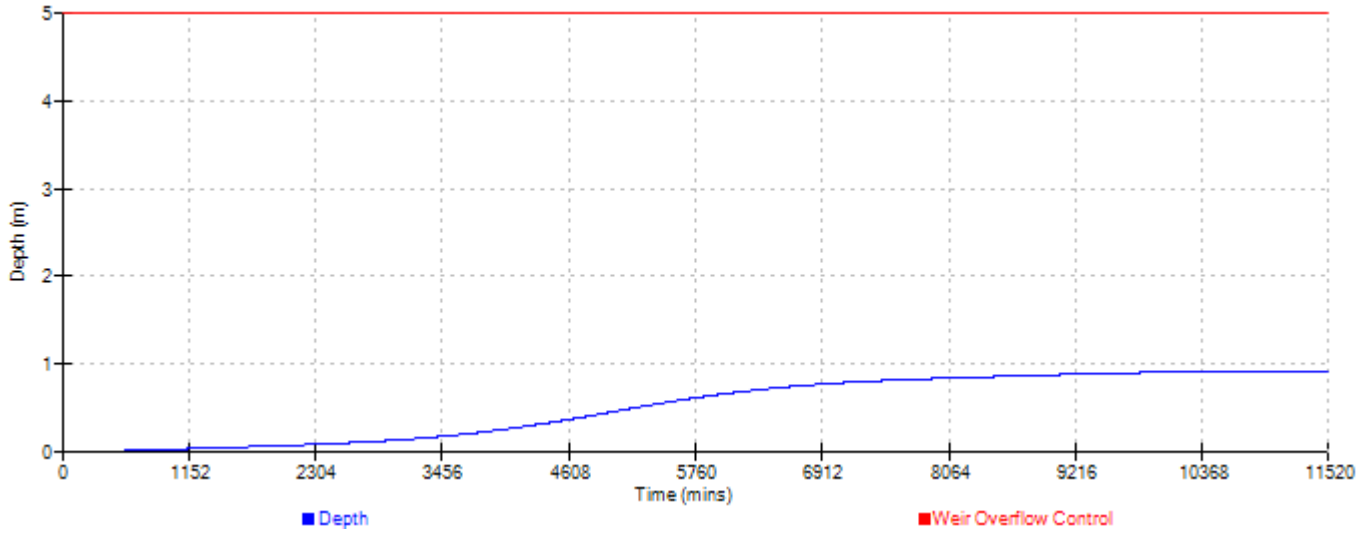
Event: 10080 min Winter







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Summary of Results for 100 year Return Period (+40%)

Outflow is too low. Design is unsatisfactory.

Storm Event	Max Level (m)	Max Depth (m)	Max Overflow (l/s)	Max Volume (m³)	Status
15 min Summer	89.402	0.402	0.0	4772.2	O K
30 min Summer	89.524	0.524	0.0	6266.5	O K
60 min Summer	89.650	0.650	0.0	7836.2	O K
120 min Summer	89.779	0.779	0.0	9463.7	O K
180 min Summer	89.854	0.854	0.0	10424.7	O K
240 min Summer	89.906	0.906	0.0	11097.1	O K
360 min Summer	89.983	0.983	0.0	12091.4	O K
480 min Summer	90.041	1.041	0.0	12847.2	O K
600 min Summer	90.087	1.087	0.0	13455.9	O K
720 min Summer	90.126	1.126	0.0	13968.2	O K
960 min Summer	90.189	1.189	0.0	14805.3	O K
1440 min Summer	90.282	1.282	0.0	16046.5	O K
2160 min Summer	90.379	1.379	0.0	17362.3	O K
2880 min Summer	90.451	1.451	0.0	18342.5	O K
4320 min Summer	90.556	1.556	0.0	19791.1	O K
5760 min Summer	90.633	1.633	0.0	20867.4	O K
7200 min Summer	90.695	1.695	0.0	21730.4	O K
8640 min Summer	90.746	1.746	0.0	22453.9	O K
10080 min Summer	90.790	1.790	0.0	23078.7	O K
15 min Winter	89.449	0.449	0.0	5344.9	O K
30 min Winter	89.584	0.584	0.0	7018.4	O K
60 min Winter	89.725	0.725	0.0	8776.6	O K
120 min Winter	89.868	0.868	0.0	10599.3	O K
180 min Winter	89.951	0.951	0.0	11675.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	138.153	0.0	0.0	19
30 min Summer	90.705	0.0	0.0	34
60 min Summer	56.713	0.0	0.0	64
120 min Summer	34.246	0.0	0.0	124
180 min Summer	25.149	0.0	0.0	184
240 min Summer	20.078	0.0	0.0	244
360 min Summer	14.585	0.0	0.0	364
480 min Summer	11.622	0.0	0.0	484
600 min Summer	9.738	0.0	0.0	604
720 min Summer	8.424	0.0	0.0	724
960 min Summer	6.697	0.0	0.0	964
1440 min Summer	4.839	0.0	0.0	1444
2160 min Summer	3.490	0.0	0.0	2164
2880 min Summer	2.766	0.0	0.0	2884
4320 min Summer	1.989	0.0	0.0	4324
5760 min Summer	1.573	0.0	0.0	5768
7200 min Summer	1.311	0.0	0.0	7208
8640 min Summer	1.129	0.0	0.0	8648
10080 min Summer	0.994	0.0	0.0	10088
15 min Winter	138.153	0.0	0.0	19
30 min Winter	90.705	0.0	0.0	34
60 min Winter	56.713	0.0	0.0	64
120 min Winter	34.246	0.0	0.0	124
180 min Winter	25.149	0.0	0.0	184

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Overflow (l/s)	Max Volume (m³)	Status
240 min Winter	90.009	1.009	0.0	12428.8	O K
360 min Winter	90.094	1.094	0.0	13542.4	O K
480 min Winter	90.158	1.158	0.0	14388.9	O K
600 min Winter	90.209	1.209	0.0	15070.6	O K
720 min Winter	90.252	1.252	0.0	15644.4	O K
960 min Winter	90.322	1.322	0.0	16581.9	O K
1440 min Winter	90.424	1.424	0.0	17972.0	O K
2160 min Winter	90.531	1.531	0.0	19445.8	O K
2880 min Winter	90.610	1.610	0.0	20543.6	O K
4320 min Winter	90.726	1.726	0.0	22166.1	O K
5760 min Winter	90.811	1.811	0.0	23371.5	O K
7200 min Winter	90.878	1.878	0.0	24338.0	O K
8640 min Winter	90.935	1.935	0.0	25148.4	O K
10080 min Winter	90.983	1.983	0.0	25848.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
240 min Winter	20.078	0.0	0.0	244
360 min Winter	14.585	0.0	0.0	364
480 min Winter	11.622	0.0	0.0	484
600 min Winter	9.738	0.0	0.0	604
720 min Winter	8.424	0.0	0.0	724
960 min Winter	6.697	0.0	0.0	964
1440 min Winter	4.839	0.0	0.0	1444
2160 min Winter	3.490	0.0	0.0	2164
2880 min Winter	2.766	0.0	0.0	2884
4320 min Winter	1.989	0.0	0.0	4324
5760 min Winter	1.573	0.0	0.0	5768
7200 min Winter	1.311	0.0	0.0	7208
8640 min Winter	1.129	0.0	0.0	8648
10080 min Winter	0.994	0.0	0.0	10088

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Rainfall Details

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)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 18.423

Time (mins) From:	To:	Area (ha)
0	4	18.423

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Model Details

Storage is Online Cover Level (m) 96.000

Tank or Pond Structure

Invert Level (m) 89.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	11596.5	1.500	13778.2	3.000	16080.4	4.500	18503.1	6.000	21055.4
0.250	11951.7	1.750	14153.6	3.250	16475.8	4.750	18918.5	6.250	21493.8
0.500	12310.3	2.000	14532.2	3.500	16874.6	5.000	19337.4	6.500	21935.8
0.750	12672.3	2.250	14914.3	3.750	17276.7	5.250	19761.5	6.750	22381.3
1.000	13037.6	2.500	15299.6	4.000	17682.1	5.500	20189.2	7.000	22830.4
1.250	13406.2	2.750	15688.3	4.250	18090.9	5.750	20620.5		

Weir Overflow Control

Discharge Coef 0.544 Width (m) 359.375 Invert Level (m) 94.000

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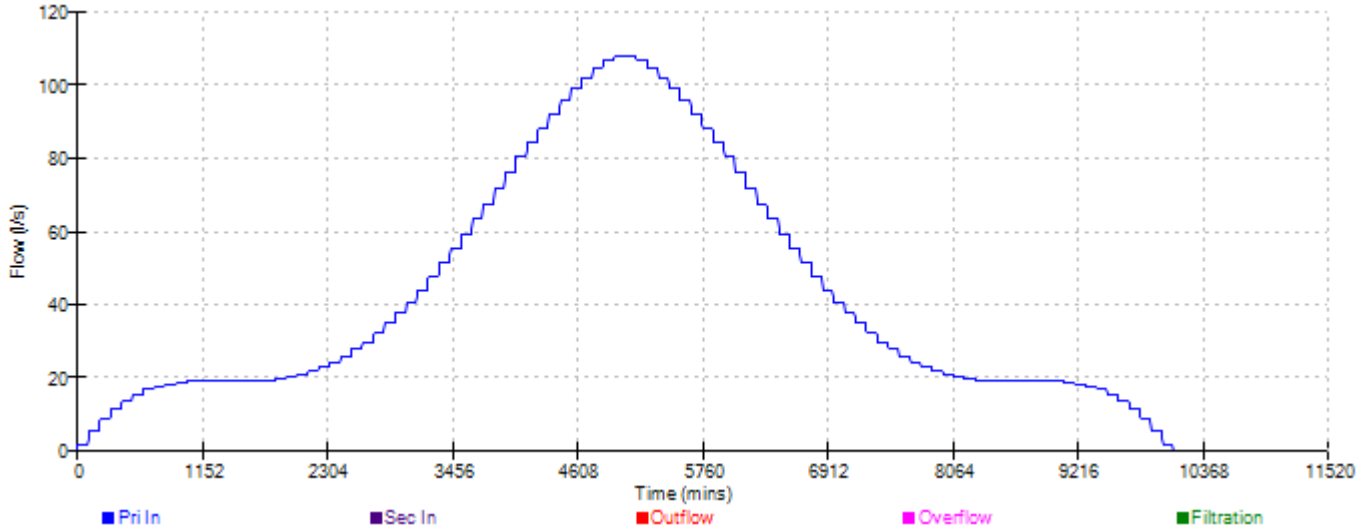
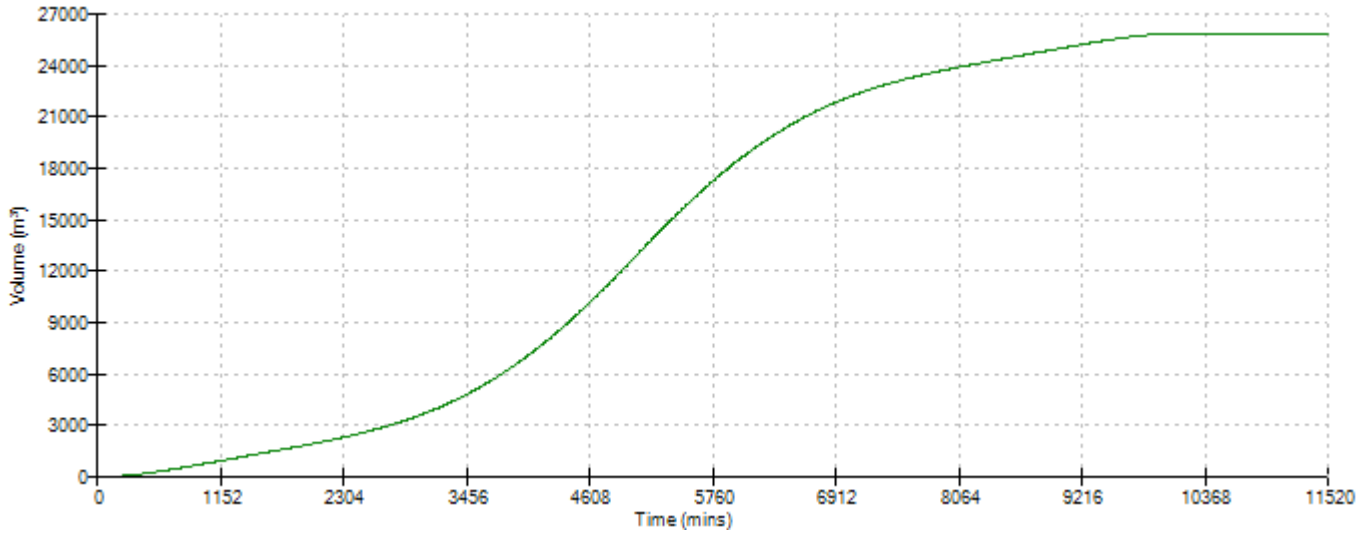
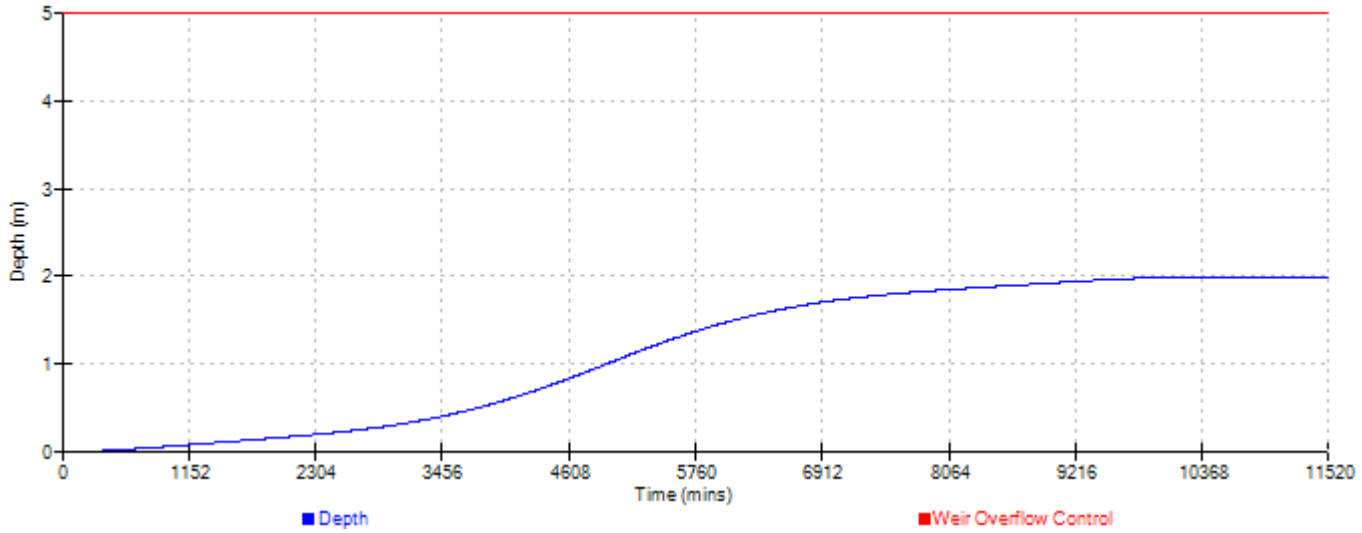
Event: 10080 min Winter







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Summary of Results for 100 year Return Period (+40%)

Outflow is too low. Design is unsatisfactory.

Storm Event	Max Level (m)	Max Depth (m)	Max Overflow (l/s)	Max Volume (m³)	Status
15 min Summer	89.568	0.568	0.0	6817.6	O K
30 min Summer	89.738	0.738	0.0	8952.2	O K
60 min Summer	89.914	0.914	0.0	11194.8	O K
120 min Summer	90.092	1.092	0.0	13519.8	O K
180 min Summer	90.196	1.196	0.0	14892.6	O K
240 min Summer	90.268	1.268	0.0	15853.3	O K
360 min Summer	90.373	1.373	0.0	17273.7	O K
480 min Summer	90.452	1.452	0.0	18353.5	O K
600 min Summer	90.515	1.515	0.0	19223.0	O K
720 min Summer	90.568	1.568	0.0	19954.9	O K
960 min Summer	90.654	1.654	0.0	21150.7	O K
1440 min Summer	90.779	1.779	0.0	22923.9	O K
2160 min Summer	90.911	1.911	0.0	24803.7	O K
2880 min Summer	91.008	2.008	0.0	26204.0	O K
4320 min Summer	91.149	2.149	0.0	28273.5	O K
5760 min Summer	91.253	2.253	0.0	29811.1	O K
7200 min Summer	91.335	2.335	0.0	31043.9	O K
8640 min Summer	91.403	2.403	0.0	32077.5	O K
10080 min Summer	91.462	2.462	0.0	32970.1	O K
15 min Winter	89.634	0.634	0.0	7635.7	O K
30 min Winter	89.823	0.823	0.0	10026.5	O K
60 min Winter	90.017	1.017	0.0	12538.2	O K
120 min Winter	90.214	1.214	0.0	15142.1	O K
180 min Winter	90.329	1.329	0.0	16679.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	138.153	0.0	0.0	19
30 min Summer	90.705	0.0	0.0	34
60 min Summer	56.713	0.0	0.0	64
120 min Summer	34.246	0.0	0.0	124
180 min Summer	25.149	0.0	0.0	184
240 min Summer	20.078	0.0	0.0	244
360 min Summer	14.585	0.0	0.0	364
480 min Summer	11.622	0.0	0.0	484
600 min Summer	9.738	0.0	0.0	604
720 min Summer	8.424	0.0	0.0	724
960 min Summer	6.697	0.0	0.0	964
1440 min Summer	4.839	0.0	0.0	1444
2160 min Summer	3.490	0.0	0.0	2164
2880 min Summer	2.766	0.0	0.0	2884
4320 min Summer	1.989	0.0	0.0	4324
5760 min Summer	1.573	0.0	0.0	5768
7200 min Summer	1.311	0.0	0.0	7208
8640 min Summer	1.129	0.0	0.0	8648
10080 min Summer	0.994	0.0	0.0	10088
15 min Winter	138.153	0.0	0.0	19
30 min Winter	90.705	0.0	0.0	34
60 min Winter	56.713	0.0	0.0	64
120 min Winter	34.246	0.0	0.0	124
180 min Winter	25.149	0.0	0.0	184

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Overflow (l/s)	Max Volume (m³)	Status
240 min Winter	90.408	1.408	0.0	17755.7	O K
360 min Winter	90.524	1.524	0.0	19346.5	O K
480 min Winter	90.611	1.611	0.0	20555.9	O K
600 min Winter	90.681	1.681	0.0	21529.7	O K
720 min Winter	90.739	1.739	0.0	22349.5	O K
960 min Winter	90.833	1.833	0.0	23688.8	O K
1440 min Winter	90.971	1.971	0.0	25674.8	O K
2160 min Winter	91.115	2.115	0.0	27780.1	O K
2880 min Winter	91.221	2.221	0.0	29348.5	O K
4320 min Winter	91.376	2.376	0.0	31666.3	O K
5760 min Winter	91.489	2.489	0.0	33388.4	O K
7200 min Winter	91.579	2.579	0.0	34769.2	O K
8640 min Winter	91.654	2.654	0.0	35926.8	O K
10080 min Winter	91.718	2.718	0.0	36926.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
240 min Winter	20.078	0.0	0.0	244
360 min Winter	14.585	0.0	0.0	364
480 min Winter	11.622	0.0	0.0	484
600 min Winter	9.738	0.0	0.0	604
720 min Winter	8.424	0.0	0.0	724
960 min Winter	6.697	0.0	0.0	964
1440 min Winter	4.839	0.0	0.0	1444
2160 min Winter	3.490	0.0	0.0	2164
2880 min Winter	2.766	0.0	0.0	2884
4320 min Winter	1.989	0.0	0.0	4324
5760 min Winter	1.573	0.0	0.0	5768
7200 min Winter	1.311	0.0	0.0	7208
8640 min Winter	1.129	0.0	0.0	8648
10080 min Winter	0.994	0.0	0.0	10088

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Rainfall Details

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)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 26.319

Time (mins) From:	To:	Area (ha)
0	4	26.319

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Model Details

Storage is Online Cover Level (m) 96.000

Tank or Pond Structure

Invert Level (m) 89.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	11596.5	1.500	13778.2	3.000	16080.4	4.500	18503.1	6.000	21055.4
0.250	11951.7	1.750	14153.6	3.250	16475.8	4.750	18918.5	6.250	21493.8
0.500	12310.3	2.000	14532.2	3.500	16874.6	5.000	19337.4	6.500	21935.8
0.750	12672.3	2.250	14914.3	3.750	17276.7	5.250	19761.5	6.750	22381.3
1.000	13037.6	2.500	15299.6	4.000	17682.1	5.500	20189.2	7.000	22830.4
1.250	13406.2	2.750	15688.3	4.250	18090.9	5.750	20620.5		

Weir Overflow Control

Discharge Coef 0.544 Width (m) 359.375 Invert Level (m) 94.000

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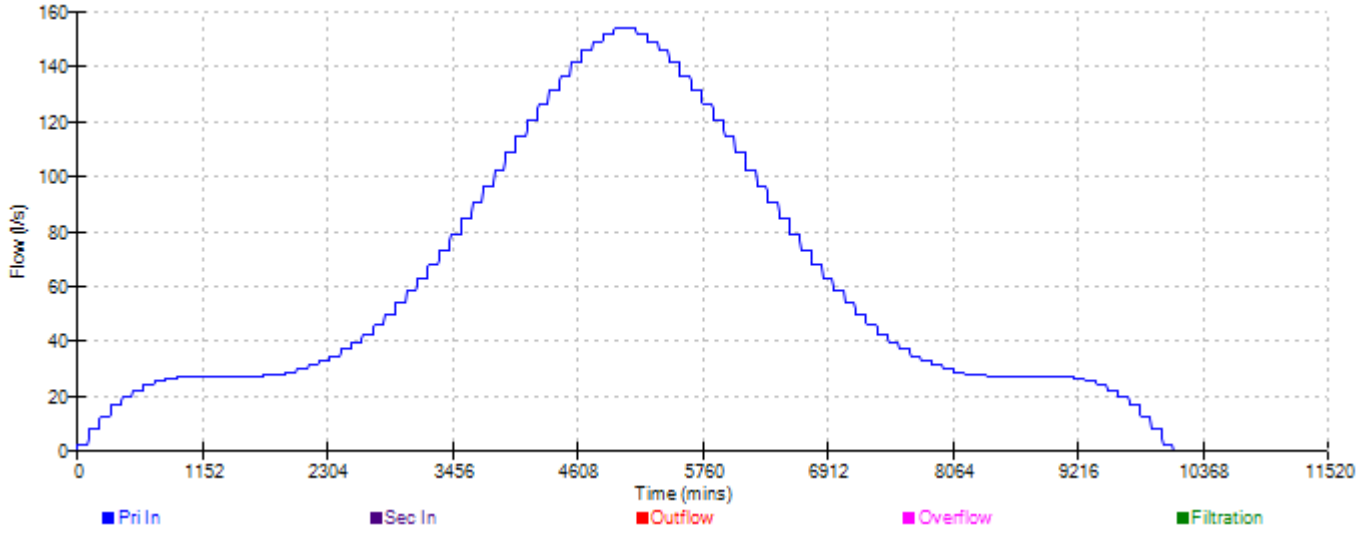
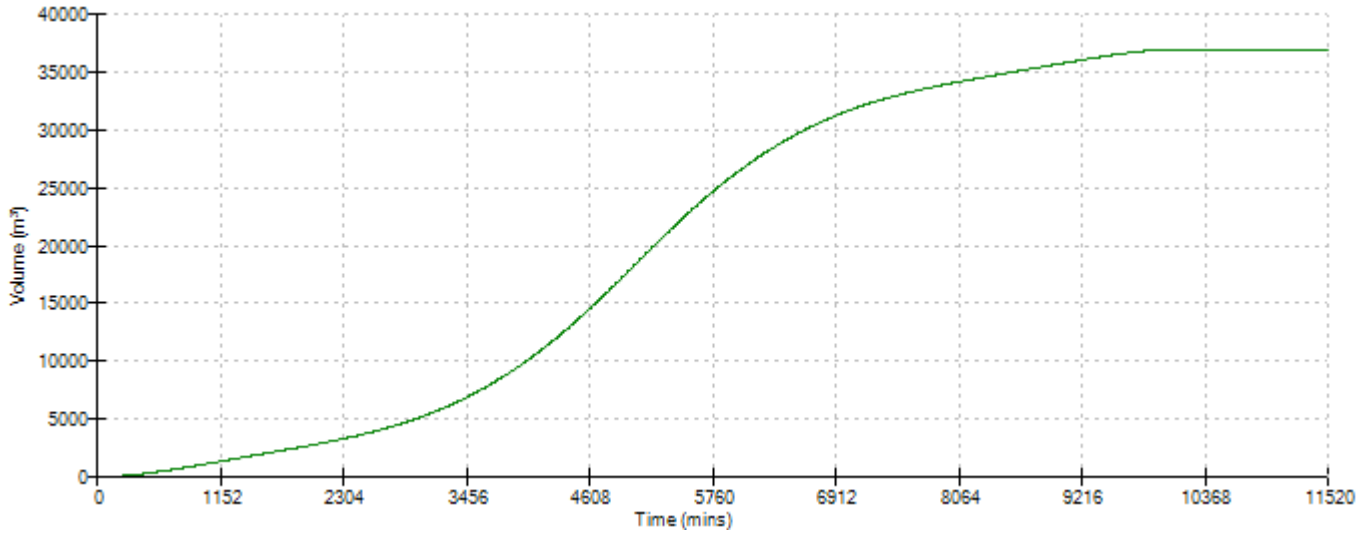
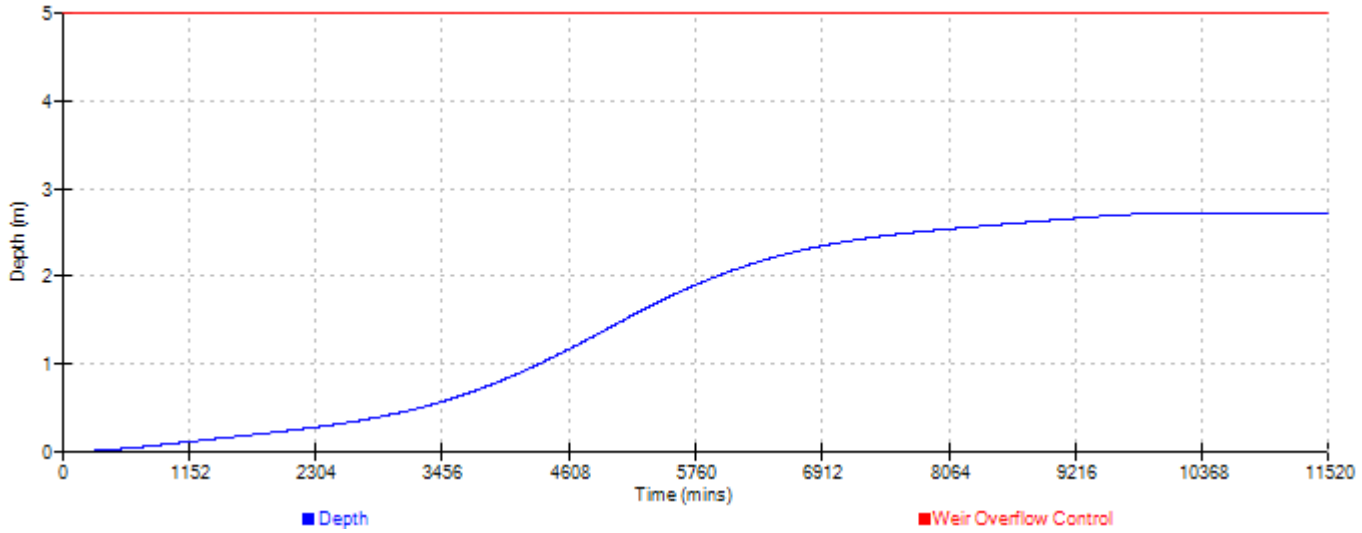
Event: 10080 min Winter







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Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 2517 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	91.710	0.710	13.7	2035.2	O K
30 min Summer	91.870	0.870	15.7	2665.0	O K
60 min Summer	92.020	1.020	17.6	3314.7	O K
120 min Summer	92.159	1.159	19.3	3962.8	O K
180 min Summer	92.231	1.231	20.3	4323.1	O K
240 min Summer	92.277	1.277	20.8	4558.5	O K
360 min Summer	92.338	1.338	21.6	4876.8	O K
480 min Summer	92.378	1.378	22.1	5090.5	O K
600 min Summer	92.405	1.405	22.4	5239.5	O K
720 min Summer	92.425	1.425	22.7	5346.2	O K
960 min Summer	92.448	1.448	23.0	5477.5	O K
1440 min Summer	92.462	1.462	23.2	5554.6	O K
2160 min Summer	92.451	1.451	23.0	5493.8	O K
2880 min Summer	92.437	1.437	22.9	5413.7	O K
4320 min Summer	92.402	1.402	22.4	5218.8	O K
5760 min Summer	92.361	1.361	21.9	4997.1	O K
7200 min Summer	92.318	1.318	21.3	4770.7	O K
8640 min Summer	92.276	1.276	20.8	4551.6	O K
10080 min Summer	92.235	1.235	20.3	4342.1	O K
15 min Winter	91.774	0.774	14.5	2280.2	O K
30 min Winter	91.946	0.946	16.7	2986.2	O K
60 min Winter	92.107	1.107	18.7	3715.5	O K
120 min Winter	92.256	1.256	20.6	4445.8	O K
180 min Winter	92.334	1.334	21.5	4853.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	138.153	0.0	19
30 min Summer	90.705	0.0	34
60 min Summer	56.713	0.0	64
120 min Summer	34.246	0.0	124
180 min Summer	25.149	0.0	184
240 min Summer	20.078	0.0	244
360 min Summer	14.585	0.0	362
480 min Summer	11.622	0.0	482
600 min Summer	9.738	0.0	602
720 min Summer	8.424	0.0	722
960 min Summer	6.697	0.0	962
1440 min Summer	4.839	0.0	1440
2160 min Summer	3.490	0.0	1840
2880 min Summer	2.766	0.0	2220
4320 min Summer	1.989	0.0	2984
5760 min Summer	1.573	0.0	3816
7200 min Summer	1.311	0.0	4616
8640 min Summer	1.129	0.0	5456
10080 min Summer	0.994	0.0	6264
15 min Winter	138.153	0.0	19
30 min Winter	90.705	0.0	34
60 min Winter	56.713	0.0	64
120 min Winter	34.246	0.0	122
180 min Winter	25.149	0.0	182

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
240 min Winter	92.384	1.384	22.2	5121.6	O K
360 min Winter	92.450	1.450	23.0	5486.4	O K
480 min Winter	92.494	1.494	23.6	5734.1	O K
600 min Winter	92.524	1.524	24.0	5909.9	O K
720 min Winter	92.547	1.547	24.2	6038.8	O K
960 min Winter	92.575	1.575	24.6	6205.6	O K
1440 min Winter	92.597	1.597	24.9	6335.9	O K
2160 min Winter	92.590	1.590	24.8	6293.6	O K
2880 min Winter	92.569	1.569	24.5	6167.1	O K
4320 min Winter	92.525	1.525	24.0	5913.6	O K
5760 min Winter	92.472	1.472	23.3	5608.7	O K
7200 min Winter	92.416	1.416	22.6	5294.7	O K
8640 min Winter	92.359	1.359	21.9	4988.9	O K
10080 min Winter	92.305	1.305	21.2	4699.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
240 min Winter	20.078	0.0	240
360 min Winter	14.585	0.0	358
480 min Winter	11.622	0.0	476
600 min Winter	9.738	0.0	592
720 min Winter	8.424	0.0	708
960 min Winter	6.697	0.0	940
1440 min Winter	4.839	0.0	1386
2160 min Winter	3.490	0.0	2032
2880 min Winter	2.766	0.0	2304
4320 min Winter	1.989	0.0	3200
5760 min Winter	1.573	0.0	4144
7200 min Winter	1.311	0.0	5040
8640 min Winter	1.129	0.0	5880
10080 min Winter	0.994	0.0	6760

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Rainfall Details

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)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 7.896

Time (mins) From:	To:	Area (ha)
0	4	7.896

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Model Details

Storage is Online Cover Level (m) 94.000

Infiltration Basin Structure

Invert Level (m) 91.000 Safety Factor 4.0
Infiltration Coefficient Base (m/hr) 0.03600 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.03600

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	2000.0	0.750	3844.3	1.500	5724.0	2.250	7639.2	3.000	9589.9
0.250	2610.8	1.000	4466.9	1.750	6358.5	2.500	8285.5		
0.500	3225.5	1.250	5093.5	2.000	6996.9	2.750	8935.7		

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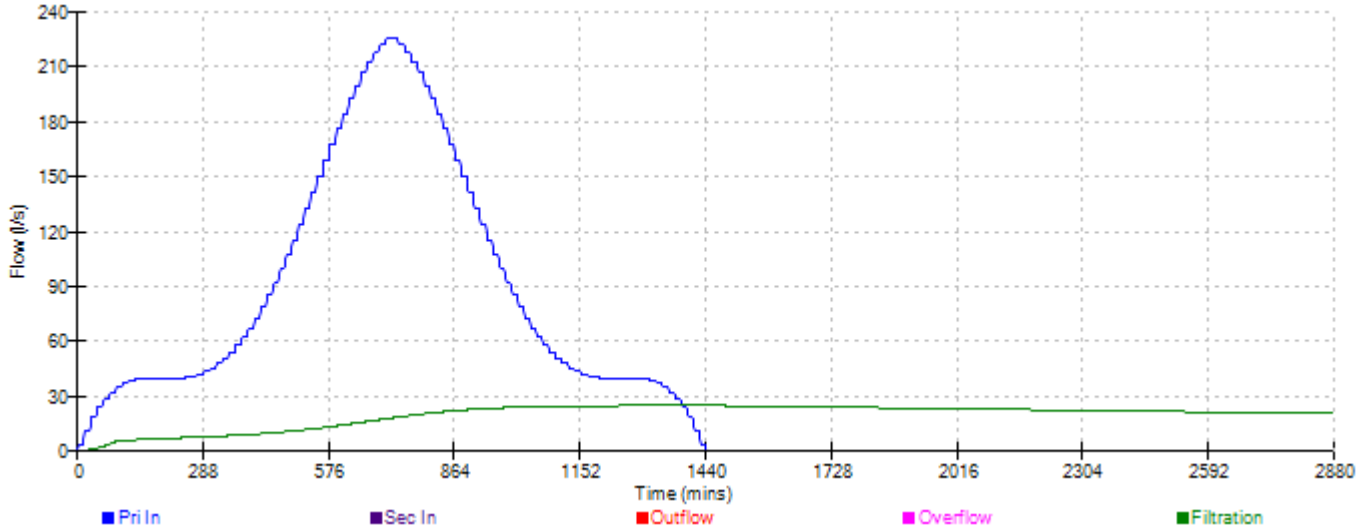
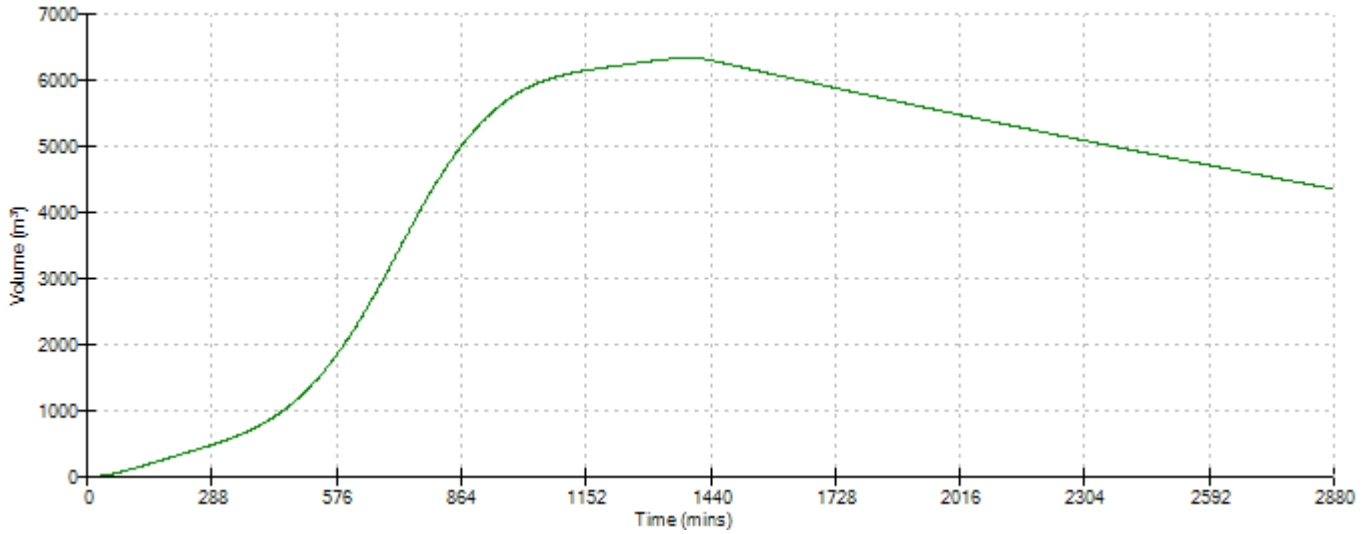
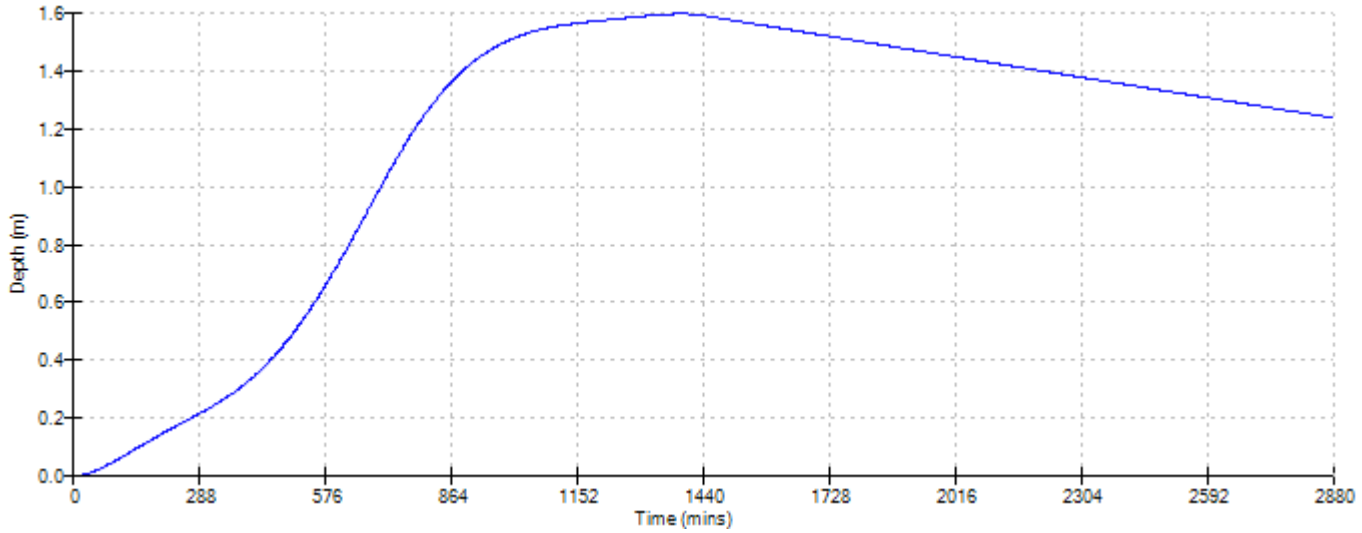
Event: 1440 min Winter







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Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 3864 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	92.316	1.316	21.3	4757.0	O K
30 min Summer	92.580	1.580	24.7	6235.0	O K
60 min Summer	92.826	1.826	27.8	7769.4	O K
120 min Summer	93.053	2.053	30.7	9320.5	O K
180 min Summer	93.174	2.174	32.3	10201.5	O K
240 min Summer	93.252	2.252	33.3	10791.7	O K
360 min Summer	93.358	2.358	34.7	11616.5	O K
480 min Summer	93.431	2.431	35.6	12197.9	O K
600 min Summer	93.483	2.483	36.3	12629.5	O K
720 min Summer	93.524	2.524	36.8	12962.4	O K
960 min Summer	93.580	2.580	37.5	13435.3	O K
1440 min Summer	93.638	2.638	38.3	13938.0	O K
2160 min Summer	93.662	2.662	38.6	14142.0	O K
2880 min Summer	93.652	2.652	38.5	14053.7	O K
4320 min Summer	93.624	2.624	38.1	13814.0	O K
5760 min Summer	93.590	2.590	37.7	13520.2	O K
7200 min Summer	93.551	2.551	37.2	13189.0	O K
8640 min Summer	93.508	2.508	36.6	12833.5	O K
10080 min Summer	93.465	2.465	36.0	12474.5	O K
15 min Winter	92.422	1.422	22.7	5328.8	O K
30 min Winter	92.703	1.703	26.2	6985.2	O K
60 min Winter	92.965	1.965	29.6	8705.8	O K
120 min Winter	93.207	2.207	32.7	10448.5	O K
180 min Winter	93.336	2.336	34.4	11441.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	138.153	0.0	19
30 min Summer	90.705	0.0	34
60 min Summer	56.713	0.0	64
120 min Summer	34.246	0.0	124
180 min Summer	25.149	0.0	184
240 min Summer	20.078	0.0	244
360 min Summer	14.585	0.0	364
480 min Summer	11.622	0.0	484
600 min Summer	9.738	0.0	602
720 min Summer	8.424	0.0	722
960 min Summer	6.697	0.0	962
1440 min Summer	4.839	0.0	1442
2160 min Summer	3.490	0.0	2160
2880 min Summer	2.766	0.0	2624
4320 min Summer	1.989	0.0	3328
5760 min Summer	1.573	0.0	4096
7200 min Summer	1.311	0.0	4904
8640 min Summer	1.129	0.0	5712
10080 min Summer	0.994	0.0	6560
15 min Winter	138.153	0.0	19
30 min Winter	90.705	0.0	34
60 min Winter	56.713	0.0	64
120 min Winter	34.246	0.0	122
180 min Winter	25.149	0.0	182

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
240 min Winter	93.420	2.420	35.5	12108.4	O K
360 min Winter	93.533	2.533	36.9	13044.5	O K
480 min Winter	93.612	2.612	38.0	13708.4	O K
600 min Winter	93.669	2.669	38.7	14204.5	O K
720 min Winter	93.713	2.713	39.3	14589.8	Flood Risk
960 min Winter	93.775	2.775	40.1	15146.6	Flood Risk
1440 min Winter	93.844	2.844	41.0	15770.2	Flood Risk
2160 min Winter	93.880	2.880	41.5	16101.4	Flood Risk
2880 min Winter	93.878	2.878	41.4	16085.8	Flood Risk
4320 min Winter	93.836	2.836	40.9	15693.2	Flood Risk
5760 min Winter	93.793	2.793	40.3	15307.1	Flood Risk
7200 min Winter	93.741	2.741	39.7	14840.9	Flood Risk
8640 min Winter	93.685	2.685	38.9	14339.0	O K
10080 min Winter	93.626	2.626	38.1	13826.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
240 min Winter	20.078	0.0	242
360 min Winter	14.585	0.0	360
480 min Winter	11.622	0.0	478
600 min Winter	9.738	0.0	596
720 min Winter	8.424	0.0	714
960 min Winter	6.697	0.0	944
1440 min Winter	4.839	0.0	1412
2160 min Winter	3.490	0.0	2080
2880 min Winter	2.766	0.0	2736
4320 min Winter	1.989	0.0	3460
5760 min Winter	1.573	0.0	4376
7200 min Winter	1.311	0.0	5264
8640 min Winter	1.129	0.0	6216
10080 min Winter	0.994	0.0	7064

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Rainfall Details

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)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 18.423

Time (mins) From:	To:	Area (ha)
0	4	18.423

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Model Details

Storage is Online Cover Level (m) 94.000

Infiltration Basin Structure

Invert Level (m) 91.000 Safety Factor 4.0
Infiltration Coefficient Base (m/hr) 0.03600 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.03600

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	2000.0	0.750	3844.3	1.500	5724.0	2.250	7639.2	3.000	9589.9
0.250	2610.8	1.000	4466.9	1.750	6358.5	2.500	8285.5		
0.500	3225.5	1.250	5093.5	2.000	6996.9	2.750	8935.7		

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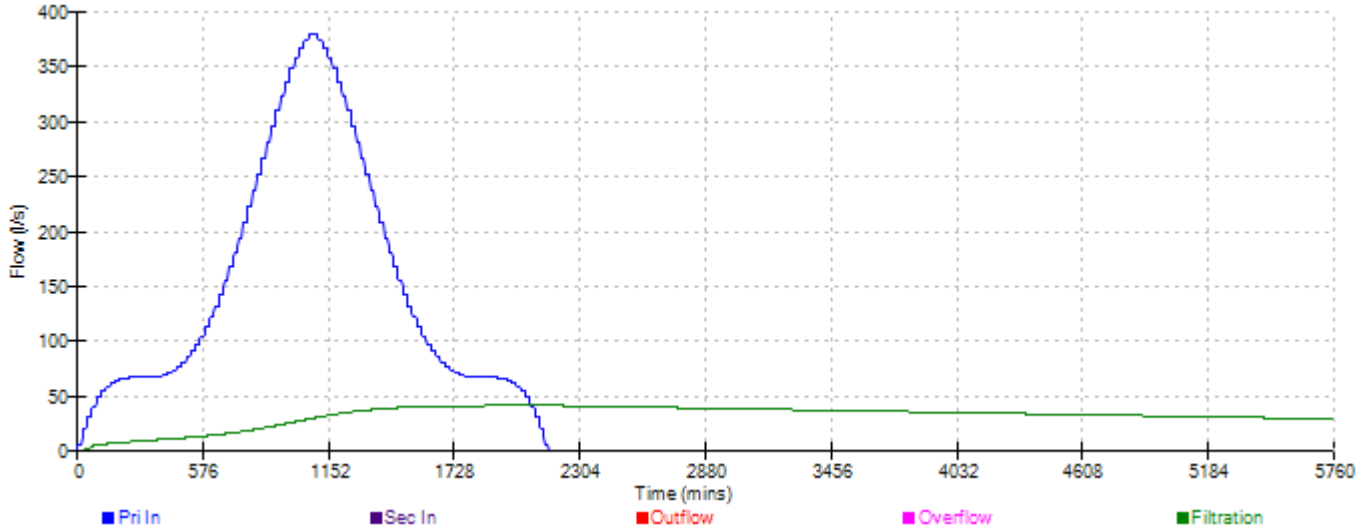
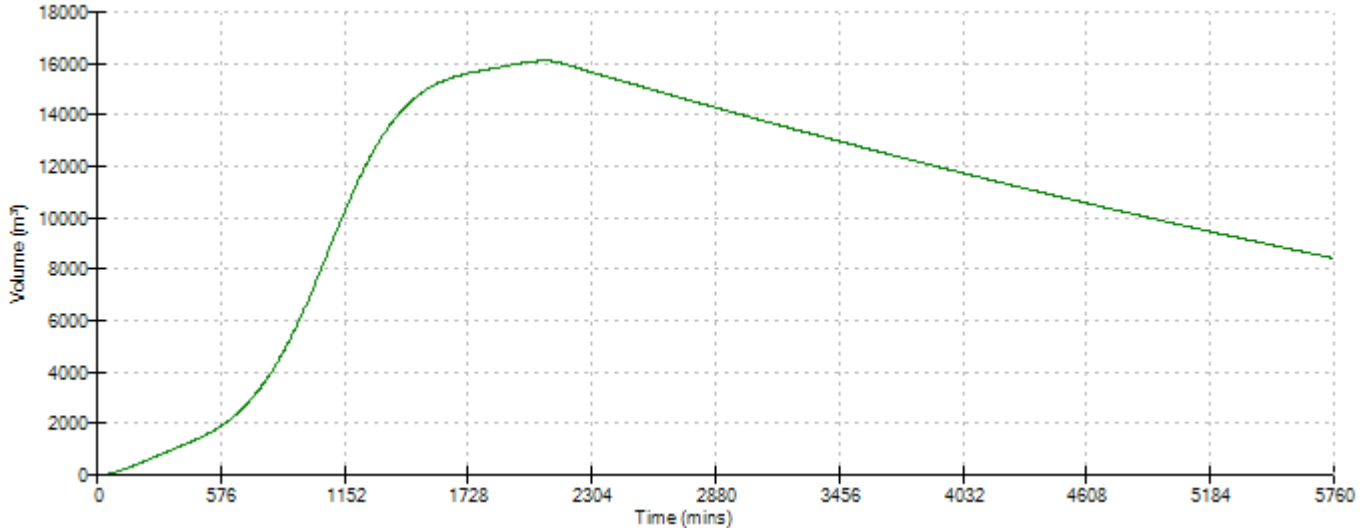
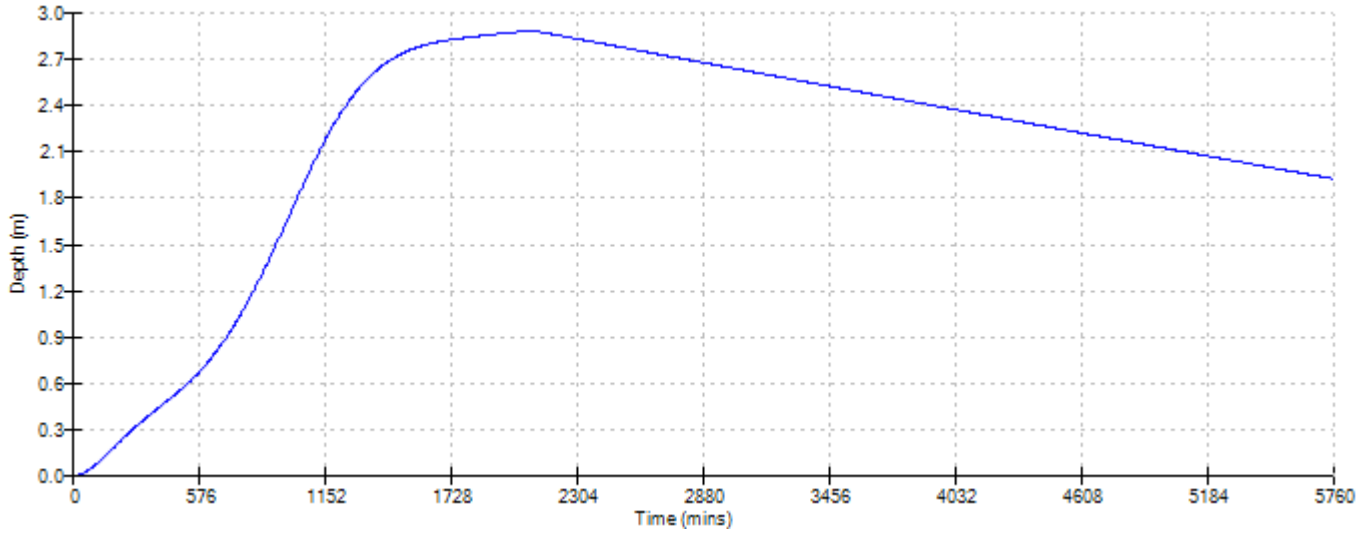
Event: 2160 min Winter







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Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 553 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	0.484	0.484	1.1	41.4	O K
30 min Summer	0.628	0.628	1.3	53.7	O K
60 min Summer	0.768	0.768	1.4	65.7	O K
120 min Summer	0.890	0.890	1.5	76.1	O K
180 min Summer	0.942	0.942	1.5	80.5	O K
240 min Summer	0.964	0.964	1.6	82.4	O K
360 min Summer	0.972	0.972	1.6	83.1	O K
480 min Summer	0.964	0.964	1.6	82.4	O K
600 min Summer	0.953	0.953	1.6	81.5	O K
720 min Summer	0.940	0.940	1.5	80.4	O K
960 min Summer	0.912	0.912	1.5	77.9	O K
1440 min Summer	0.849	0.849	1.5	72.6	O K
2160 min Summer	0.765	0.765	1.4	65.4	O K
2880 min Summer	0.692	0.692	1.3	59.1	O K
4320 min Summer	0.568	0.568	1.2	48.6	O K
5760 min Summer	0.467	0.467	1.1	40.0	O K
7200 min Summer	0.385	0.385	1.0	32.9	O K
8640 min Summer	0.316	0.316	1.0	27.0	O K
10080 min Summer	0.259	0.259	0.9	22.1	O K
15 min Winter	0.542	0.542	1.2	46.4	O K
30 min Winter	0.705	0.705	1.3	60.3	O K
60 min Winter	0.864	0.864	1.5	73.9	O K
120 min Winter	1.005	1.005	1.6	85.9	O K
180 min Winter	1.068	1.068	1.7	91.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	138.153	0.0	19
30 min Summer	90.705	0.0	34
60 min Summer	56.713	0.0	64
120 min Summer	34.246	0.0	122
180 min Summer	25.149	0.0	182
240 min Summer	20.078	0.0	242
360 min Summer	14.585	0.0	360
480 min Summer	11.622	0.0	414
600 min Summer	9.738	0.0	476
720 min Summer	8.424	0.0	540
960 min Summer	6.697	0.0	674
1440 min Summer	4.839	0.0	952
2160 min Summer	3.490	0.0	1364
2880 min Summer	2.766	0.0	1760
4320 min Summer	1.989	0.0	2552
5760 min Summer	1.573	0.0	3336
7200 min Summer	1.311	0.0	4040
8640 min Summer	1.129	0.0	4760
10080 min Summer	0.994	0.0	5544
15 min Winter	138.153	0.0	19
30 min Winter	90.705	0.0	33
60 min Winter	56.713	0.0	62
120 min Winter	34.246	0.0	120
180 min Winter	25.149	0.0	178

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
240 min Winter	1.096	1.096	1.7	93.7	O K
360 min Winter	1.115	1.115	1.7	95.3	O K
480 min Winter	1.108	1.108	1.7	94.8	O K
600 min Winter	1.091	1.091	1.7	93.3	O K
720 min Winter	1.078	1.078	1.7	92.1	O K
960 min Winter	1.042	1.042	1.6	89.1	O K
1440 min Winter	0.957	0.957	1.6	81.8	O K
2160 min Winter	0.836	0.836	1.4	71.5	O K
2880 min Winter	0.731	0.731	1.3	62.5	O K
4320 min Winter	0.558	0.558	1.2	47.7	O K
5760 min Winter	0.424	0.424	1.1	36.3	O K
7200 min Winter	0.319	0.319	1.0	27.2	O K
8640 min Winter	0.233	0.233	0.9	19.9	O K
10080 min Winter	0.165	0.165	0.8	14.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
240 min Winter	20.078	0.0	236
360 min Winter	14.585	0.0	346
480 min Winter	11.622	0.0	452
600 min Winter	9.738	0.0	494
720 min Winter	8.424	0.0	564
960 min Winter	6.697	0.0	720
1440 min Winter	4.839	0.0	1024
2160 min Winter	3.490	0.0	1468
2880 min Winter	2.766	0.0	1900
4320 min Winter	1.989	0.0	2720
5760 min Winter	1.573	0.0	3464
7200 min Winter	1.311	0.0	4248
8640 min Winter	1.129	0.0	4936
10080 min Winter	0.994	0.0	5648

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Rainfall Details

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)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.163

Time (mins) From:	To:	Area (ha)
0	4	0.163

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Model Details

Storage is Online Cover Level (m) 2.500

Cellular Storage Structure

Invert Level (m) 0.000 Safety Factor 4.0
Infiltration Coefficient Base (m/hr) 0.10800 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.10800

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	90.0	90.0	1.200	90.0	237.6	1.201	0.0	237.6

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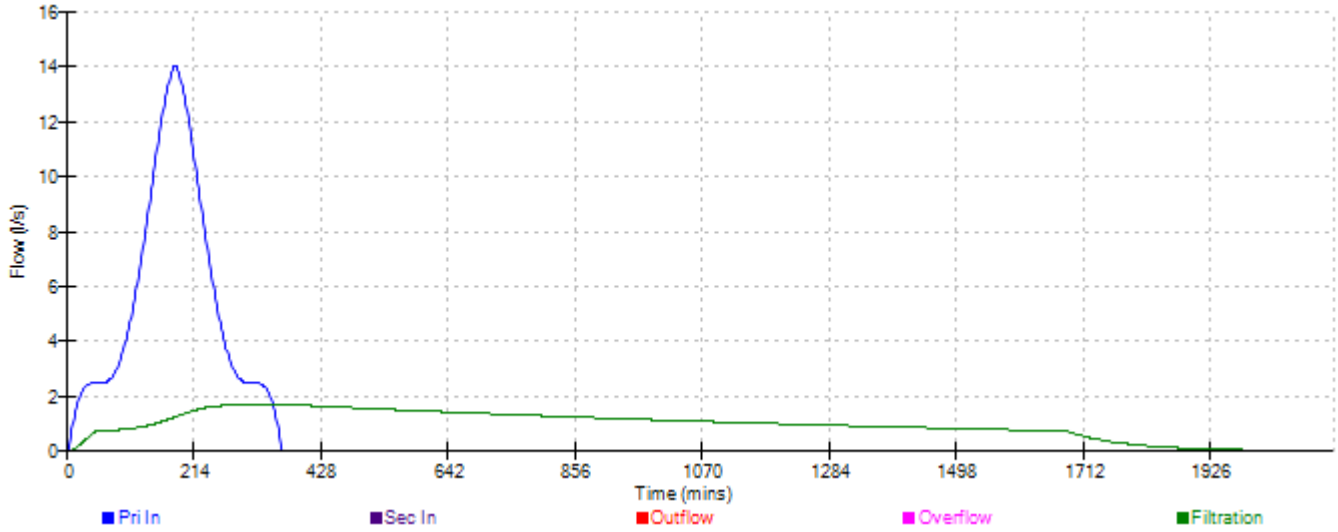
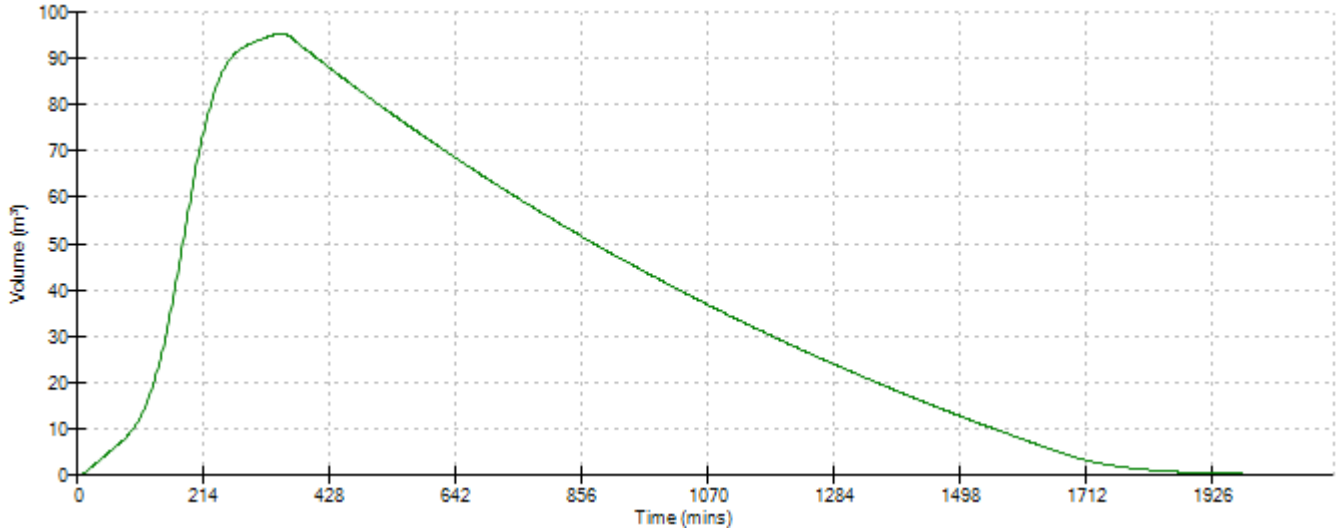
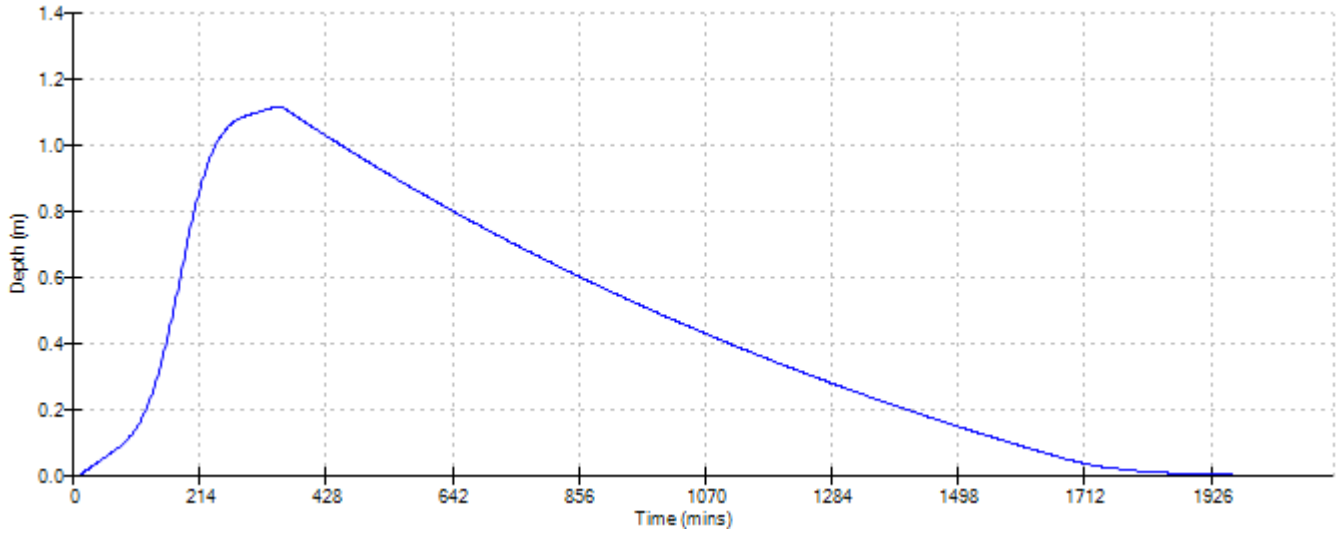
Event: 360 min Winter







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