LANMOR Consulting

Civil Engineers & Transport Planners

Land West of Station Road, Lingfield

Flood Risk Assessment

March 2022

211493/FRA/MN/KBL/KBL

Rev A

LANMOR Consulting

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1 INTRODUCTION

1.1 General

1.1.1 Lanmor Consulting Ltd have been appointed to provide flood and drainage advise in relation to the proposed development at Land West of Station Road, Lingfield, RH7 6AG.

1.1.2 Within this statement, detailed considerations will be given to the risk of flooding to the development and strategy for dealing with additional surface runoff from the site. Figure 1.1 shows the location of the site.

Figure 1.1 – Site Location

1.1.3 This statement will demonstrate that the proposals will have no impact on the current flooding in the area and that the flood risk will not be increased as a result of the proposed development.

1.1.4 This report will focus on the following:

- Location of the site;
- Development proposals;
- Existing information on extents and depths of flood events or on flood predictions;
- Sources of flooding;
- Flooding impact on proposed site;
- Safe access and egress from the site;
- An assessment of the likely run-off to be generated at the site
- Consider the use of Sustainable Urban Drainage Systems as an option for dispose of surface water run-off from the proposed development
- Undertake drainage assessment regarding the proposed buildings to establish discharge rates and attenuation requirements tank requirements to deal with any increased surface water run-off.

This FRA report has been prepared in accordance with the requirements of the National Planning Policy Framework (NPPF) and will demonstrate that the proposed development will be safe and will not increase the risk of flooding in the surrounding areas.

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2 BASELINE PARAMETERS

2.1 Site Description and Existing Conditions

2.1.1 The site is situated to the west of Lingfield Station and North of the B2028. The application site is bounded by the B2028 to the south, Station Road to the east and residential properties & the Swan Public house to the west.

2.1.2 The site is currently vacant consisting of open fields, there is fall in the ground from the northwest to the southeast, a topographical survey of the site is included within Appendix A as Drawing 17555, sheets 1-4.

2.2 Development Proposals

2.2.1 The proposed application seeks to construct a total of 99 residential dwellings. Main access to the development will be off the B2028 to the south. This link into the internal estate roads. The properties will be served off the main east-west route with a branch to the north.

2.2.2 The masterplan for the development has been included in Appendix A as drawing 2661-C-1005. This shows the layout of the development and location of the proposed residential properties.

2.3 Existing Geology

2.3.1 The British Geological Survey indicates that the site sits over a bedrock of Upper Tunbridge Wells Sand consisting of Sandstone and Siltstone, Interbedded. Sedimentary bedrock formed between 139.4 and 133.9 million years ago during the Cretaceous period.

2.3.2 There are no recorded superficial deposits overlaying the bedrock. Site investigations were undertaken in February 2022 by Your Environment, this consisted of a number of trial pits and infiltration tests. Three infiltration tests were undertaken to the north, south and middle of the application site. The tests were all conducted in accordance with BRE 365, the water level in all the trial pits failed to drop over the initial 2 hours period. An infiltration rate was not able to be calculated. The soakaway test results are included in Appendix B.

3 FLOOD RISK

3.1 Fluvial/Tidal Flooding

3.1.1 Detailed flood information was requested from the Environmental agency (EA) for the site. The National Planning Policy Framework (NPPF) defines the flood zones as the following:

- Zone 1: 'Low Probability': This comprises land assessed as having a less than 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 sea flooding (≥0.5%) in any year.

- Zone 3b: 'The Functional Floodplain' – This zone comprises of land where water must flow or be stored in times of flood. The 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 EA) including water conveyance routes.

3.1.2 The most significant source of fluvial flooding to the development would come from Eden Brook stream directly south east of the site. The watercourse presents the greatest risk of fluvial flooding to the site and the EA flood mapping indicates most of the application site lies within Flood Zone 1, with the south of the site being in flood zone 2. Figure 3.1 below shows the location of the site and its relationship to the flood zone, provided by the EA.

Figure 3.1 – EA Flood Map

3.1.3 The dark blue shaded areas indicate the extent of Flood Zone 3 and the light blue shows Flood Zone 2, the unshaded areas indicate Flood Zone 1. The information provided by the EA shows the site is located mainly within Flood Zone 1. It therefore has a less than 1 in 1000 annual probability of river flooding (<0.1%). The greatest risk of fluvial flooding to the site comes from Eden Brook, south east of the site approximately 46m away.

3.2 Surface Water Flooding

3.2.1 The surface water flood mapping, provided by the EA, is the best available source of national information on surface water flooding. It is a starting point for understanding patterns and probability of surface water flooding. The EA accept that the mapping has limitations and state that '*these maps cannot definitively show that an area of land or property is, or is not, at risk of flooding, and the maps are not suitable for use at an individual property level*'.

3.2.2 The site is indicated as having a very low risk of surface water flooding, as shown in Figure 3.2 below. The SFRA prepared by Tandridge also shows that the site is at low risk to surface water flooding as indicated on Map C4 included in Appendix B. It is therefore considered that the site is in a location where there is low risk of surface water flooding.

Figure 3.2 – EA Surface Water Flood Map

3.3 Groundwater Flooding

3.3.1 Mapping provided as part of the SFRA indicates that the area around the site has a negligible risk of ground water flooding. Map C4 included in Appendix B shows the risk of ground water flooding to the site.

3.4 Sewer Flooding

3.4.1 There are no sewers within the site so the risk of sewer flooding affecting it is low.

3.5 Historic Flooding

3.5.1 Records from the SFRA show historic flooding has not affected the application site, with the exception of the very southern tip.

4 FLOOD PROBABILITY AND CLIMATE CHANGE

4.1 Flood Probability

4.1.1 The main source of flood risk to the site is the Eden Brook, which is located approximately 46m to the east of the site. Information provided from the Environmental Agency (EA) states that the site is situated mainly in the Flood Zone 1 with a small part in flood zone 2.

4.1.2 Detailed flood information was requested from the EA; however, they do not have any detailed modelling in the location so were unable to confirm any flood level or provide and mapping. In order to assess the extent of flooding for an event with a probability of 1.0% or 1 in 100 years the flood outline from the EA website have been compared to the topographical survey to estimate potential flood levels.

4.1.3 When compared to the site survey the extent of flooding from a 1.0% (FZ3) probability event doesn't cross the site, the 0.1% (FZ2) probability event does cross the site. Flood extent for zone 2 follows the 51.8m contour line where it enters the and exists at the site around the 50.8m contour line. This is in line with the general fall in the area along the line of the brook, which falls the same level over this length also.

4.1.4 Given the fall on the land it is difficult to predict accurately the flood levels for such an event, but for the benefit of this report the flood levels for the 0.1% event have been assumed at 51.8m were flooding enters the site to the north, 50.8m to the south and towards the middle of the flood extent 51. 3m AOD. These are indicated on the Drawing 211493/FRA/01 which also show the flood extents for Zones 2 and 3 extracted from the EA flood map and is included in Appendix C.

4.1.5 Drawing 211493/FRA/02 included in Appendix C shows the flood extents superimposed on the site master plan. This clearly demonstrates that the proposed development will be located in flood zone 1 only the amenity space to the south will be located in flood zone 2. The proposed development is therefore considered to be at a low risk of flooding.

4.2 Climate Change

4.2.1 Past, present, and future emissions of greenhouse gases are expected to cause significant global climate change during this century – the nature if climate change at regional level will vary. The NPPF recommends that FRA's should consider the future flood levels and the impact climate change may have on rising sea levels, increased rainfall etc.

4.2.2 The climate change allowances are based on the River Management Catchment Area, the flood vulnerability and the life expectancy of the development. Under Flood Risk Assessments: Climate Change Allowances published on the gov.uk website it sets out the level of allowance to be applied to peak river flows depending on the flood zone and use.

4.2.3 The application site is a residential development so under table 2 of the PPG for NPPF it is categorised as a "more vulnerable" use, it is located in flood zone 1 so no allowance needs to be applied, however the southern tip of the site is in flood zone 2. So, for more vulnerable uses in flood zone 2 the "central Allowance" should be applied.

4.2.4 The application site is located in the Medway Management Catchment area and as it is residential it is expected to have a 100-year life expectancy. From the DEFRA website for climate changes for the central allowance a 27% increase in the peak river flows should be allowed.

4.2.5 The EA have not been able to provide any river flows or levels, therefore when applying the climate change allowance, a precautionary approach has been taken and flood zone 2 extent has been used as the maximum that flood zone 3 might extent to when climate change allowances are factored in. This is considered to be a conservative estimate of the flooding for an event with a probability of 1.0% + 27% CC allowance.

4.2.6 In summary a flood event with a 1.0% +CC allowance will not reach the proposed development.

5 IMPACTS OF FLOODING

5.1 Impacts on Flood Waters

5.1.1 The proposed development is located in Flood Zone 1 so has a less than 0.1% probability of fluvial flooding. When climate change allowances are factored in the proposed properties will be still out of the flood extent for an event with a probability of 1.0% + 27% CC allowance.

5.1.2 Given the proposed buildings will be out site of the above flood event they will not present any restriction to the free flow of flood waters.

5.2 Impact on Storage Volumes

5.2.1 The proposed development will not result in the loss of flood storage volumes with a probability of 1.0% + 27%CC, as no building will be located in this area just the open amenity space.

5.3 Flood Impact on Development

5.3.1 The proposed development will be located in Flood Zone 1, the above assessment has demonstrated that once climate change allowances are factored in proposed building will still free of flooding with a probability of 1.0% + 27% allowance.

5.3.2 The proposed buildings across the site will be set approximately 150mm above the existing ground level. The 4 properties along the south eastern boundary are located on the edge of the Flood Zone 2 extent as shown on drawing 211493/FRA/02 therefore as a precaution these properties will be a minimum of 300mm above ground level to ensure there is a 300mm freeboard above the flood event for a 1.0% + CC probability.

5.4 Safe Access

5.4.1 The site is located within a Flood Zone 1, the access to the application site will be off the B2028 which also in flood zone 1 and some distance from flood zones 2 & 3.

5.4.2 Therefore, a safe dry access can be provided to all properties during an extreme flood event.

6 SEQUENTIAL TEST

6.1.1 The aim of a sequential test is *"to demonstrate that there are no reasonable available sites in areas with a lower probability of flooding that would be appropriate to the type of development or land use proposed. A sequential approach should be used in areas known to be at risk from other forms of flooding"*.

6.1.2 The proposed development involves the construction of 99 new residential units which are classified as 'more vulnerable' according to the NPPF. The proposed development is within Flood Zone 1 with the southern part of the site being flood zone 2.

6.1.3 A sequential approach has been applied across the site to allocate the more vulnerable uses (residential properties) to areas at less risk of flooding. All the proposed dwellings will be allocated to Flood Zone 1 with a less than 0.1% probability of flooding, only the amenity area will be within Flood Zone 2.

6.1.4 The proposals therefore meet the requirements of the sequential test to allocated more vulnerable uses to low flood risk areas.

7 DRAINAGE

7.1 Existing Drainage

7.1.1 The existing site is currently greenfield, and the ground generally falls from the northwest to southeast. The topographical survey shows a ditch located along the south eastern boundary of the site and a site investigation has been carried out to confirm the condition of the possible discharge point. It is likely that surface water runoff generated from the site drains towards the existing ditch.

7.1.2 Southern Water sewer records have also been obtained to establish any existing sewer networks in the vicinity of the site. The records only show a public foul sewer within the vast area around the site. A copy of the sewer records has been included in Appendix D.

7.2 Proposed Surface Water Drainage

7.2.1 Sustainable Drainage Systems were considered as part of this assessment for the disposal of surface water run-off from the development. The proposed dwellings will incorporate the use of pitched roofs and therefore the use of green roofs cannot be accommodated.

7.2.2 Rainwater harvesting was also considered to re-use surface water run-off for the development. These systems require a separate network of pipework within the development, tanks and pumps to store the rainwater and distribute it throughout. To implement a rainwater harvesting systems on the site it was considered impractical within the site due to being excessive for the development.

7.2.3 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.

7.2.4 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.

7.2.5 Next on the Sustainable Drainage Hierarchy is the use of ground infiltration techniques such as soakaways and infiltration basins. As identified, the ground conditions consist of sand and gravel which overlays clay. Infiltration testing has been carried out throughout the site however a percolation rate was not able to be calculated as the entire site is practically impermeable. The use of soakaways is therefore not a viable option and has been discounted due to poor infiltration.

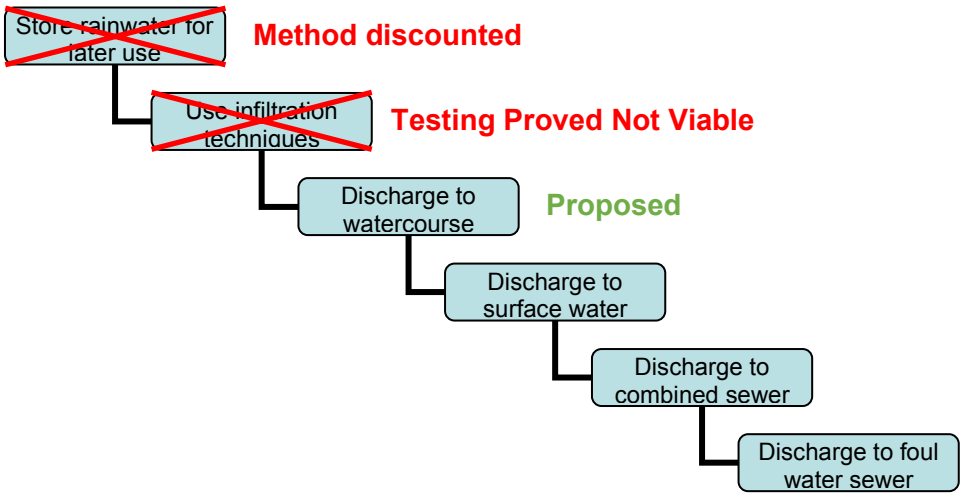


Figure 7.1 – Sustainable Drainage Hierarchy

7.2.6 Discharge to a watercourse is the next option on the Sustainable Drainage Hierarchy. A ditch is located along the south eastern boundary of the site and it is therefore proposed to utilise this as a point of discharge for surface water runoff generated from the proposed development.

7.2.7 In order to ensure there is no increase in flood risk on site or downstream as a result of the development, the proposed discharge rate will be limited as close to the greenfield rate as possible and attenuation storage provided on site. The surface water runoff will drain to various storage facilities on site including swales, attenuation tanks, permeable paving, oversized pipes and finally a pond located in the south east corner of the site which will discharge runoff to the existing ditch via a pump.

7.2.8 Calculations have been undertaken to determine the greenfield runoff rates for the existing site, listed in table 7.1 below. The full calculations are included in Appendix D.

Return Period	Rate
Q_{BAR}	32.0 l/s
1 in 1	27.2 l/s
1 in 30	72.4 l/s
1 in 100	101.9 l/s

Table 7.1 – Greenfield Runoff Rates

7.2.9 The existing Q_{BAR} rate has been calculated to be 32l/s, the proposed discharge rate from the development will reduce this by 50% to 15l/s. The proposed dwellings, access roads and hardstanding areas will drain to various storage structures including the use of permeable paving which will act as a storage facility. All structures will cascade into the pond located to the southeast of the site via pipework.

7.2.10 Based on the restricted discharge rate of 15l/s, the proposed pond has been sized to cater for a 1 in 100-year event plus 40% climate change allowance, with a minimum of 1001.7m^3 in storage volume. The pond has been designed at a depth of 1.4m, the maximum depth of water in the pond will be approximately 1.0m therefore allowing a 400mm freeboard. The discharge from the pond will be restricted by the use of a pump, before the discharge to the watercourse.

7.2.11 An indicative drainage layout for the proposed development has been prepared and is included in Appendix D as drawing 211493/DS/01. MicroDrainage has been used to design the storage structures along with the greenfield calculations, a copy of these calculations is included in Appendix D.

7.3 Surface Water / SuDS Maintenance

7.3.1 Regularly 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.

7.3.2 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".

7.3.3 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 and infiltration reconditioning if required.

7.3.4 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.

7.3.5 Following completion of the development a Management Company will be set up to maintain all the communal areas, including the drainage. It will be their responsibility to maintain the drainage network, including the SuDS elements.

7.4 Attenuation Tanks

7.4.1 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 7.2 – Attenuation Tank Maintenance

7.5 Inspection, Manhole, Catchpit Chambers and Pipes

7.5.1 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.

7.5.2 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.

7.5.3 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 7.3 – Manhole, Catchpit and Pipes Maintenance

7.6 Permeable Paving

7.6.1 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.
Occasional maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds	As required- once per year on less frequently used pavements
Remedial Actions	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 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 7.4 – Permeable Paving Maintenance Schedule

7.7 Ponds and Wetlands

7.7.1 "Ponds and wetlands will require regular maintenance to ensure continuing operation to design performance standards, and all designers should provide detailed specifications and frequencies for the required maintenance activities, along with likely machinery requirements and typical annual costs – within the Maintenance Plan. 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 7.5 – Pond and Wetland Maintenance

8 MANAGING POLLUTION RISK FROM SURFACE WATER

8.1.1 As part of the CIRIA SuDS Manual C753, Section 26 provides guidance regarding methods for managing pollution risks from surface water runoff.

8.1.2 Part of the assessment is to determine which land use classification the proposed development falls under, Table 26.1 of the CIRIA Report C753 reproduced as table 8.1 below sets the approaches to water quality risk management. For this site the Simple Index Approach will be used.

TABLE 26.1 Approaches to water quality risk management

Design method	Hazard characterisation	Risk reduction	
		For surface water	For groundwater
Simple index approach	Simple pollution hazard indices based on land use (eg Table 26.2 or equivalent)	Simple SuDS hazard mitigation indices (eg Table 26.3 or equivalent)	Simple SuDS hazard mitigation indices (eg Table 26.4 or equivalent)
Risk screening'	Factors characterising traffic density and extent of infiltration likely to occur (eg Table 26.5 or equivalent)	N/A	Factors characterising unsaturated soil depth and type, and predominant flow type through the soils (eg Table 26.5 or equivalent)
Detailed risk assessment	Site specific information used to define likely pollutants and their significance	More detailed, component specific performance information used to demonstrate that the proposed SuDS components reduce the hazard to acceptable levels	
Process-based treatment modelling	Time series rainfall used with generic pollution characteristics to determine statistical distributions of likely concentrations and loadings in the runoff	Models that represent the treatment processes in the proposed SuDS components give estimates of reductions in event mean discharge concentrations and total annual load reductions delivered by the system	

Table 8.1 – Extract from CIRIA SuDS Manual C753 (Approaches to Water Quality)

8.1.3 Table 26.2 in C753 reproduced as Table 8.2, show the potential hazard associated with different land uses the hazard indices. The development will consist of residential houses, it is concluded that the site should be classed within the sections shown in Table 4.2 below.

8.1.4 The roofs of the residential buildings is considered to have a “very low” pollution hazard, generating 0.2 total suspended solids, 0.2 metals and 0.05 hydro-carbons. The access and parking area is considered to have a “low” pollution hazard, generating 0.5 total suspended solids, 0.4 metals and 0.4 hydro-carbons.

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) (< 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[2]	High	0.8[2]	1.8[2]	0.9[2]

Table 8.2 – Extract from CIRIA SuDS Manual C753 (Land use classifications)

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

8.1.6 Table 26.3 of C753 reproduced below as Table 8.3 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

	Mitigation indices[1]		
Type of SuDS component	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 8.3 – Extract from CIRIA SuDS Manual C753 (Mitigation Indices to Surface Water)

8.1.7 The swales will provide mitigation of 0.5 for total suspended solids, 0.6 for metals and 0.6 for hydrocarbons. Permeable paving will provide mitigation of 0.7 for total suspended solids, 0.6 for metals and 0.7 for hydrocarbons. The pond will provide mitigation of 0.7 for total suspended solids, 0.7 for metals and 0.5 for hydrocarbons. These are all greater than the pollution hazard indices identified in table 8.2 above. The above assessment has demonstrated that the proposed SuDS features will provide a suitable level of treatment appropriate to the type of development proposed.

9 SUMMARY

9.1.1 The application is for the construction of 99 residential dwellings and garages across the application area. They will be linked via footways and interlinking roads.

9.1.2 As the site is situated in Flood Zone 1, the proposed development will therefore not be subjected to fluvial flooding from an event with a probability of 0.1% including allowances for Climate Change. Other sources of flooding have also been considered and the flood risk they pose is also very low. Safe and dry access can always be provided to and from the site during flood events, therefore there is no residual risk to the residents.

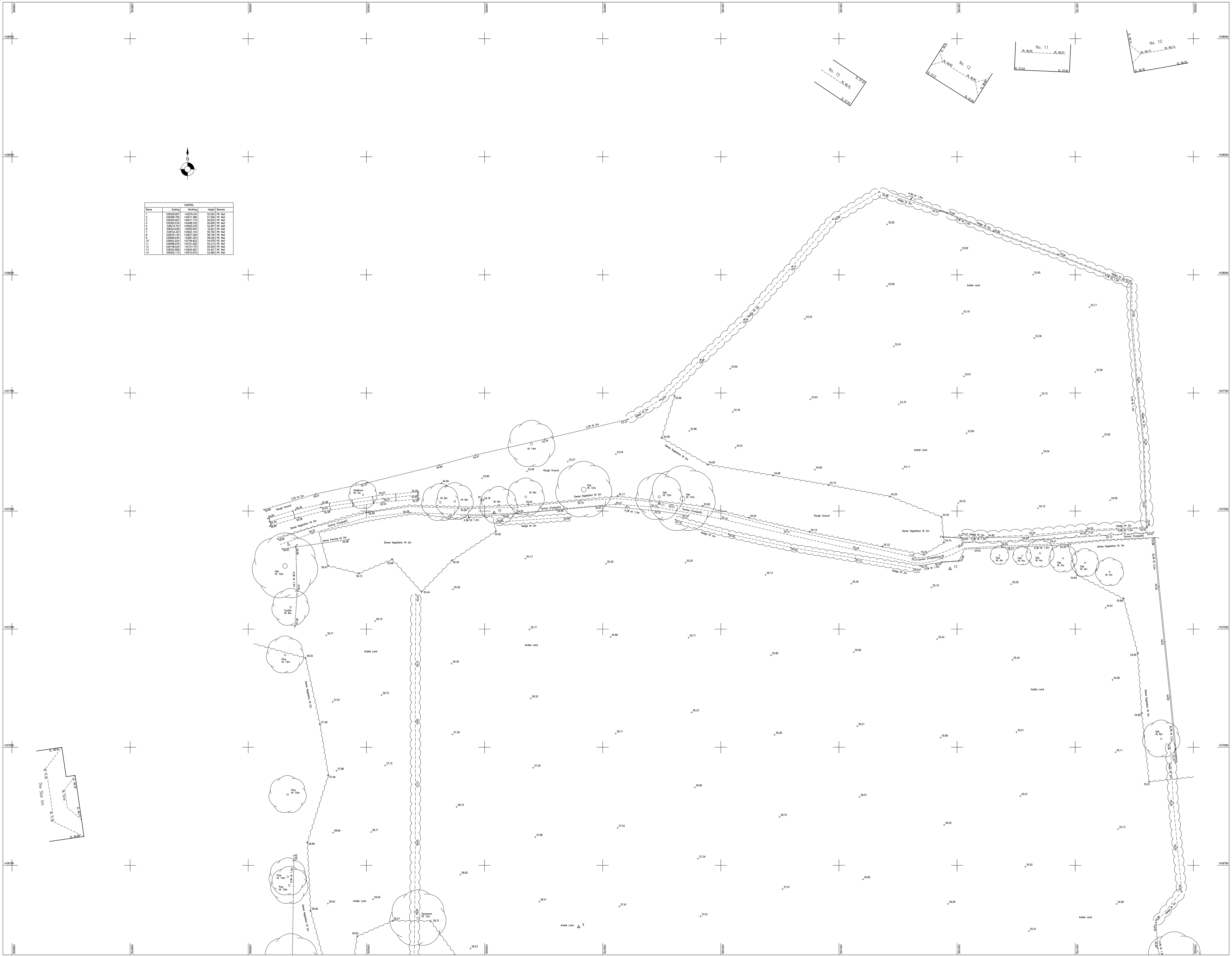
9.1.3 The site meets the Sequential Test to allocate development to land at less risk of flooding as it is in a low flood risk area. The NPPF states the site does not require an Exception Test, indicating this site is suitable for the proposed development.

9.1.4 Due to the nature of the soil on site and poor infiltration, the use of infiltration techniques has been discounted. As there is a ditch located along the southeast boundary of the site, it would allow for a suitable discharge point for surface water runoff from the development. Various attenuation structures will be provided on site before cascading into a pond located in the southeast corner of the site which will then be pumped to the existing ditch at a restricted rate of 15l/s.

9.1.5 This report has found the proposed development site to be at low risk of flooding from various sources. The proposals will not result in an increase in flood risk to the site or the surrounding area. Therefore, we see no reason why this application should not be approved on the grounds of flooding.

APPENDIX A

Drawing 17555 – Topographical Survey Sheets 1 - 4



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Legend:

Abbreviated Features:

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Av.	Average
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BB	Belisha Beacon
BH	Borehole
BL	Bed Level
BS	Bus Stop
BT	British Telecom Cover
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Br/W	Brick Wall
CATV	Cable TV Cover
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C/RW	Concrete Retaining Wall
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DPC	Damp Proof Course
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1 2 3 4

Notes:

REV NO	REV NOTE	DATE	SIGNED

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THE SURVEY ASSOCIATION

smas — safety | management | advisory | services

GLOBAL SURVEYS

6 Franklin's Close, Ecton, Northants, NN6 0QG
Tel: 01604 491543 Fax: 01604 790361
Email: info@globalsurveys.co.uk

Site: The Old Cottage, Station Road, Lingfield

Client: Woolbro Morris Ltd

Survey Description: Topographical Survey

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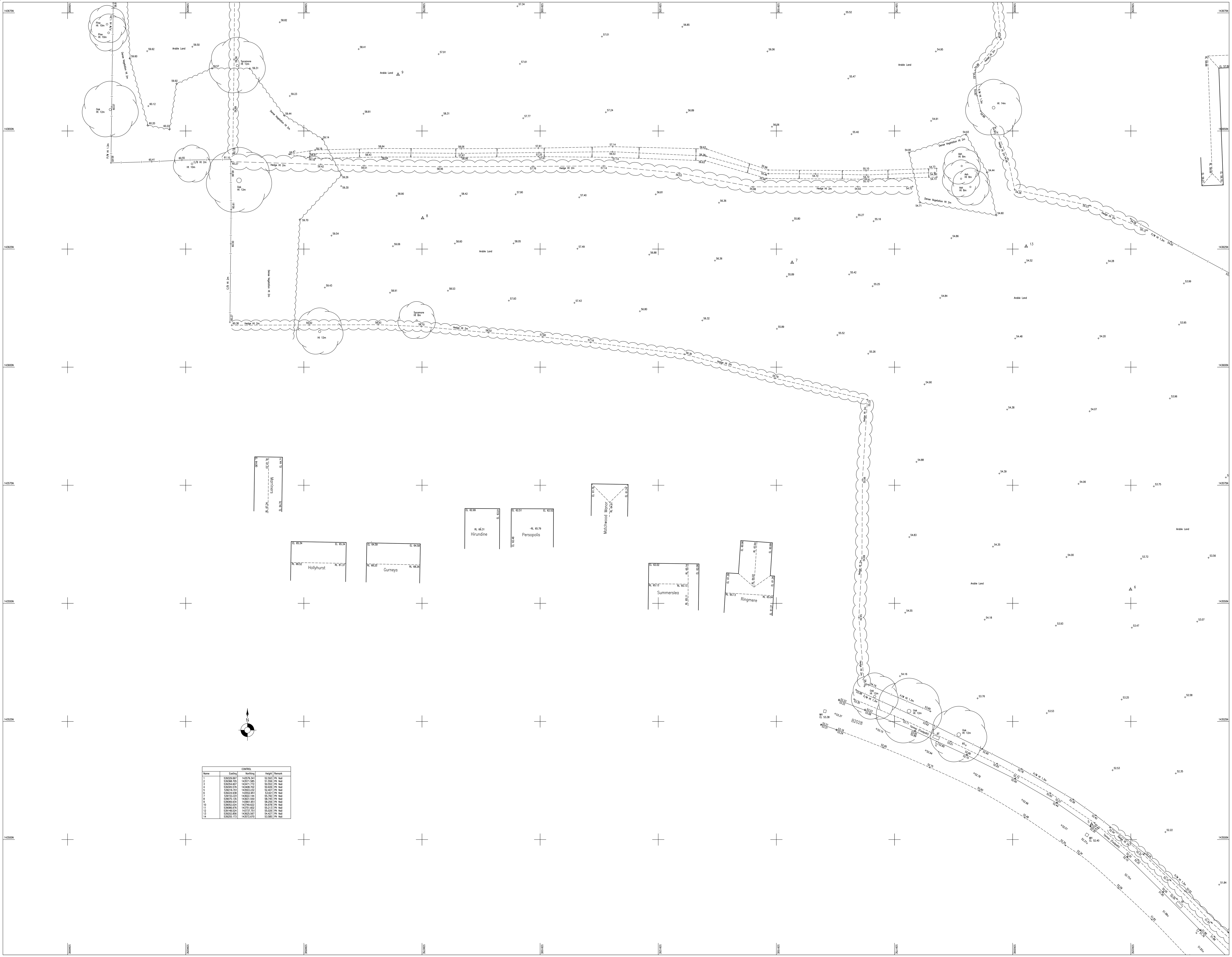
Dwg No.	17555–Topo	Surveyor	SPH
Sheet	1 of 4	Checked	MSW



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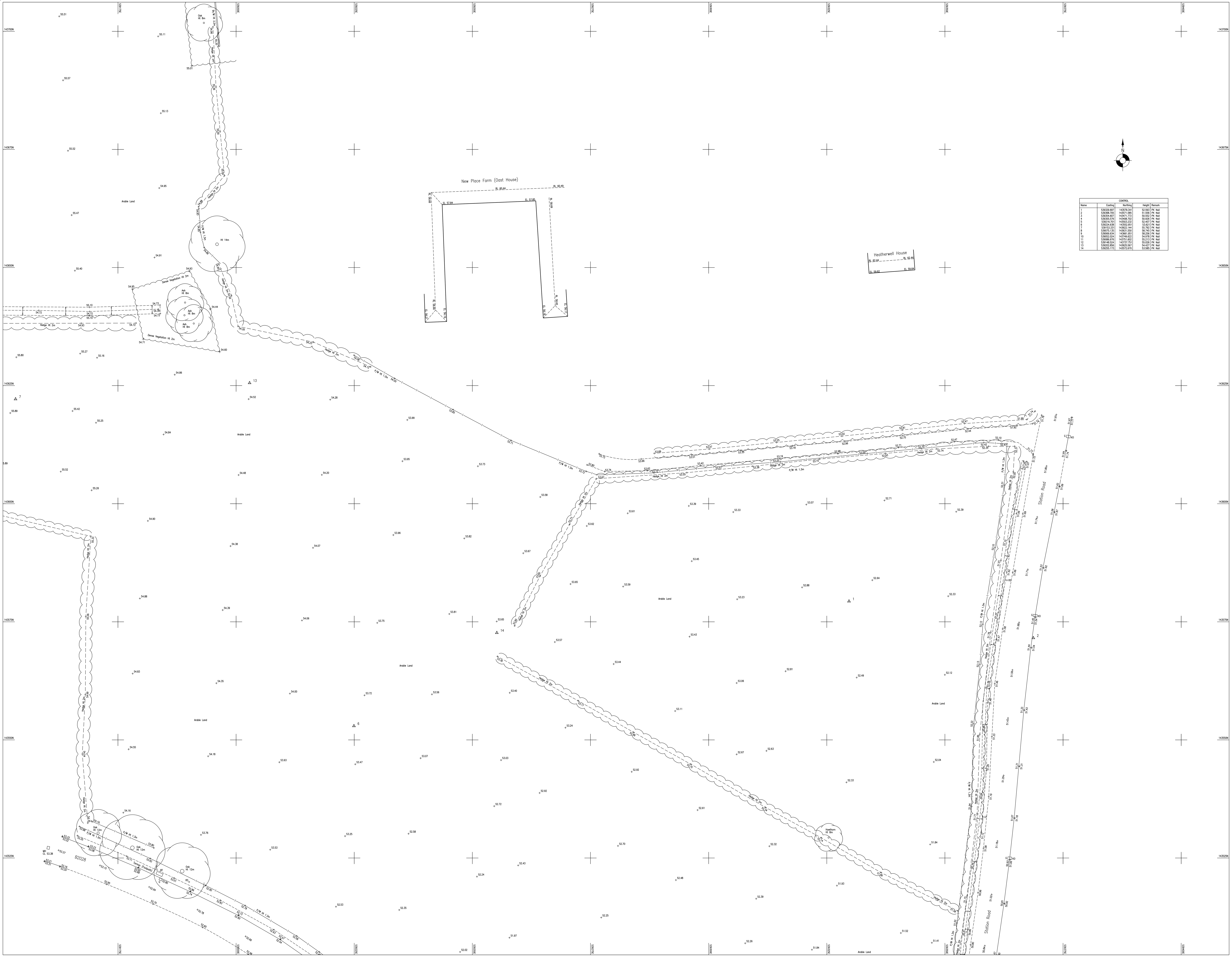

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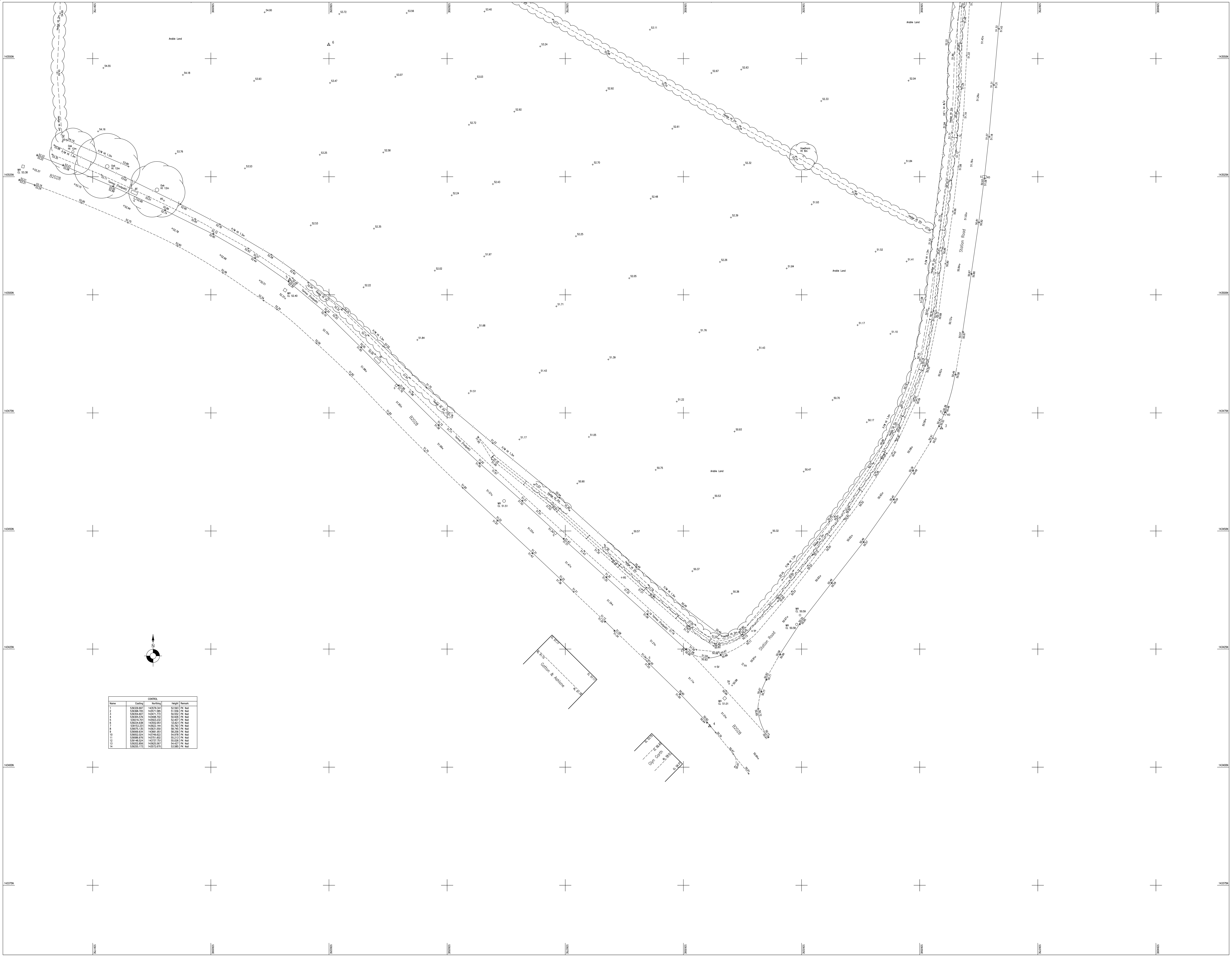

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Dwg No.	17555–Topo	Surveyor	SPH
Sheet	4 of 4	Checked	MSW

Drawing 2661-C-1005 – Proposed Site Plan

N

0m 10m 20m 30m 40m 80m
Scale

Omega Architects
The Front Barn, 124 Manor Road North,
Thames Ditton Surrey, KT7 0BH
T: 01372 470 313 W: www.omega-architects.co.uk

Client
WOOLBRO MORRIS

Project
LAND AT THE OLD COTTAGE,
STATION ROAD, LINGFIELD

Drawing title
SKETCH SCHEME 5

Scale	Drawn	Check	Date
1:500 @ A0	S SB JC/G	RN JL JL	TJ 04.02.22 TJ 09.02.22 TJ 11.02.22

Project No.	Class	Dwg No.	Status	Rev.
2661	C	1005	SK	5D

APPENDIX B

Infiltration Test Report

YEX3560
Land at Station Road – RH7 6AG
February 22

Dear Lanmor Consulting,

Please find below the results of your Infiltration testing. The information contained below is a summary of the site works carried out on 07th February 2022.

Geology

An examination of the available British Geological Survey data of the area for the site has been examined and indicates that the site has no superficial drift deposits recorded, and bedrock deposits recorded as the Upper Tunbridge Wells Sand (sandstone and siltstone).

Fieldworks

The programme of this investigation included the excavation of three trial pits. The locations of the soakaway tests were selected by the client. During this work, the soils encountered were logged in general accordance with BS5930: 1990, as amended in 2007.

Percolation Testing

During the soakaway tests the water failed to achieve a fall from 75% to 25% of the effective depth of the storage volume in TP01 and TP03. The results obtained from the soakaway tests are summarised below:

WS	Dimensions (m)	Depth (m)	Soil Description	Infiltration Rate (m/sec)	Drainage Characteristics
TP01	1.30 x 0.40	1.50	Brown CLAY	N/A	Practically Impermeable
TP02	1.20 x 0.40	1.50	Orangish brown SAND. Sand is medium	N/A	Practically Impermeable
TP03	1.20 x 0.40	1.40	Brown CLAY	N/A	Practically Impermeable

Conclusion

The soils encountered beneath the site were found to be predominantly CLAY. The soakage rates obtained during the investigation were found to be poor to practically impermeable. Given the data from the test, it is considered that soakaways are not suitable for this site.

References

- Building Research Establishment (BRE) Digest 365, *Soakaway Design*, September 1991.
- British Standards Institution (1999) BS5930: *Code of practice for site investigations*, B.S.I., London.
- British Standards Institution (2007), Amendment No 1, BS5930: *Code of practice for site investigations*, B.S.I., London.

Please do contact me on 01243 787150 or 07758 162624 should you have any questions.

Regards

Nick Hammond
Geo-Environmental Engineer

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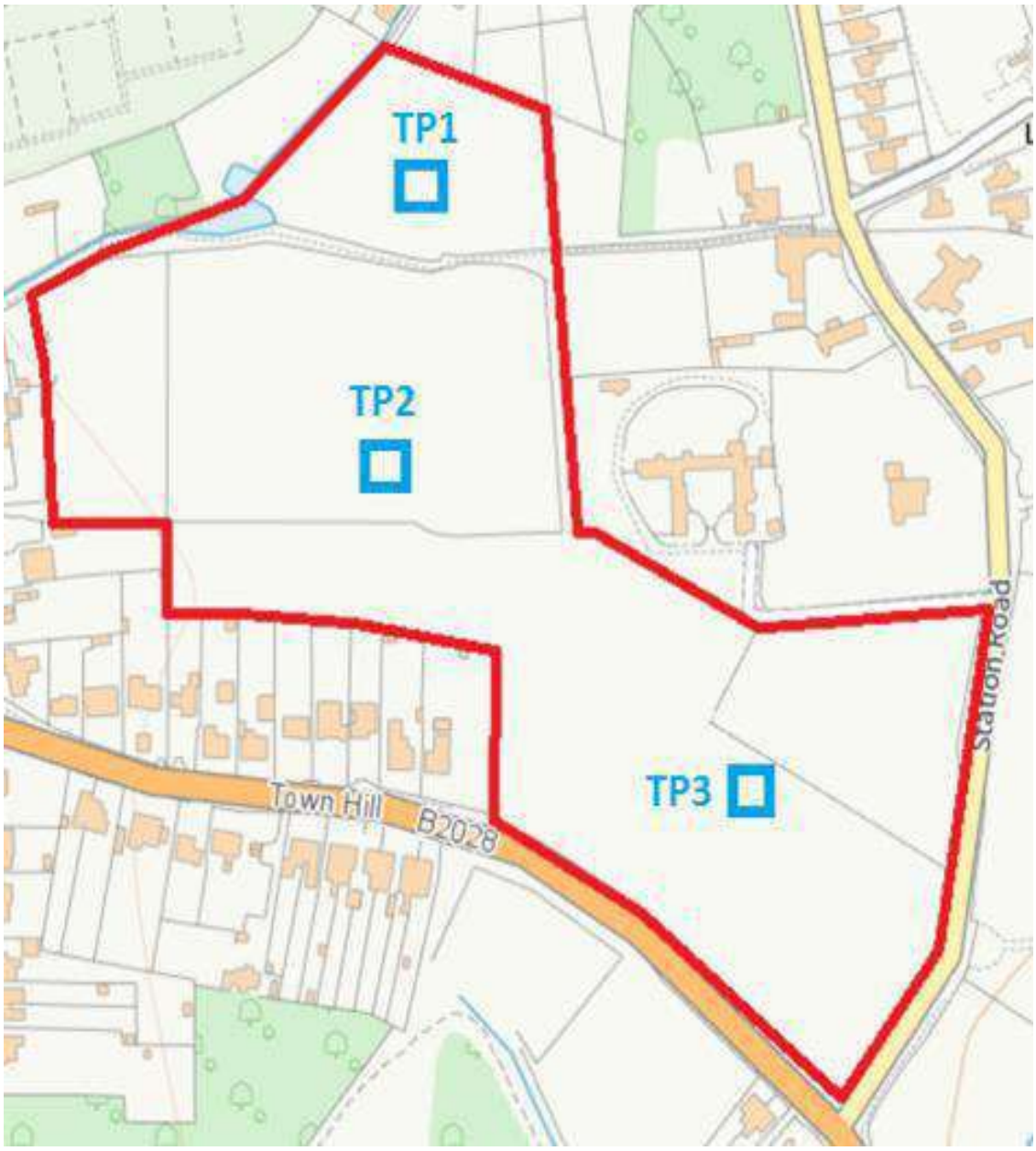

Site Investigation Plan

YOUR ENVIRONMENT

Land at Station Road
YEX3560
Feb-22

Appendix B

www.yourenvironment.org
info@yourenvironment.org
01243 787150

Log of Boring	TP1
Sheet 1 of	1

YE Engineer N. Hammond

Location	Land at Station Road, Lingfield, RH7 6AG
Date	February 7, 2022
Project Reference	YEX3560

Water level data

Completion: Depth NA m
Elevation NA m

24 hour: Depth ____ m
Elevation ____ m

Width 0.4 m
Length 1.3 m
Depth 1.5 m

Method (Trial pit, window etc) Trial Pit - Machine Excavation

Stratum depth (m) From	Stratum depth (m) To	Sample Depth From (m)	Sample Depth To (m)	Sample Type	GW	Install Details	LITHOLOGY
0.00	0.40					NONE	Brown gravelly, clayey SAND. Sand is fine - medium. Gravel is medium - coarse, angular of mixed lithology.
0.40	1.20						Orangish brown sandy CLAY. Sand is medium - coarse.
1.20	1.50						Orangish brown sandy, gravelly CLAY. Sand is fine - medium. Gravel is medium - coarse, angular of mudstone and sandstone fragments.
							End of TP1

Remarks: .

www.yourenvironment.org
info@yourenvironment.org
01243 787150

Log of Boring	TP2
Sheet 1 of	1

YE Engineer N. Hammond

Location	Land at Station Road, Lingfield, RH7 6AG
Date	February 7, 2022
Project Reference	YEX3560

Water level data

Completion: Depth NA m
Elevation NA m

24 hour: Depth ____ m
Elevation ____ m

Width 0.4 m
Length 1.2 m
Depth 1.5 m

Method (Trial pit, window etc) Trial Pit - Machine Excavation

Stratum depth (m) From	Stratum depth (m) To	Sample Depth From (m)	Sample Depth To (m)	Sample Type	GW	Install Details	LITHOLOGY
0.00	0.40					NONE	Brown gravelly, clayey SAND. Sand is fine - medium. Gravel is medium - coarse, angular of mixed lithology.
0.40	1.00						Orangish brown sandy CLAY. Sand is medium - coarse.
1.00	1.50						Orangish brown gravelly, sandy CLAY. Sand is fine - medium. Gravel is medium - coarse, angular of mudstone and sandstone fragments.
							End of TP2

Remarks: .

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Log of Boring	TP3
Sheet 1 of	1

YE Engineer N. Hammond

Location	Land at Station Road, Lingfield, RH7 6AG
Date	February 7, 2022
Project Reference	YEX3560

Water level data

Completion: Depth NA m
Elevation NA m

24 hour: Depth ____ m
Elevation ____ m

Width 0.4 m
Length 1.2 m
Depth 1.4 m

Method (Trial pit, window etc) Trial Pit - Machine Excavation

Stratum depth (m) From	Stratum depth (m) To	Sample Depth From (m)	Sample Depth To (m)	Sample Type	GW	Install Details	LITHOLOGY
0.00	0.40					NONE	Brown gravelly, clayey SAND. Sand is fine - medium. Gravel is medium - coarse, angular of mixed lithology.
0.40	0.80						Orangish brown sandy CLAY. Sand is medium - coarse.
0.80	1.40						Orangish brown gravelly, sandy CLAY. Sand is fine - medium. Gravel is medium - coarse, angular of mudstone and sandstone fragments.
							End of TP3

Remarks: .

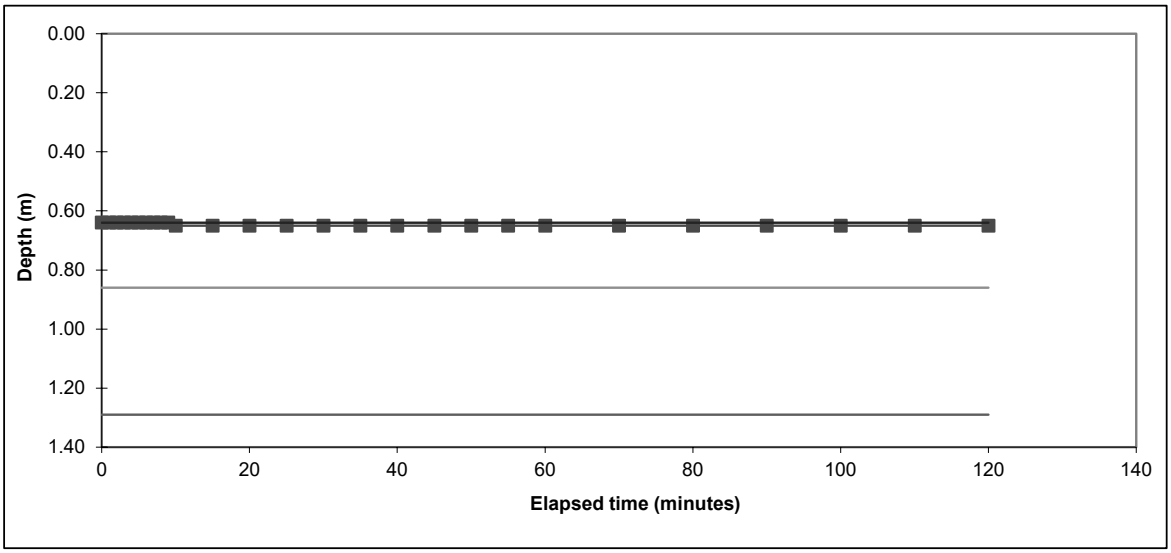
Appendix C

Your Environment

Soakaway Test

Trial Pit No:	TP1	Test No:	1	Date:	07/02/2022
Length (m):	1.300		Datum Height:	0.00	m agl
Width (m):	0.40		Granular infill:	None	
Depth (m):	1.50		Porosity of infill:	1	(assumed)

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	0.640	30	0.650
1	0.640	35	0.650
2	0.640	40	0.650
3	0.640	45	0.650
4	0.640	50	0.650
5	0.640	55	0.650
6	0.640	60	0.650
7	0.640	70	0.650
8	0.640	80	0.650
9	0.640	90	0.650
10	0.650	100	0.650
15	0.650	110	0.650
20	0.650	120	0.650
25	0.650		



Start water depth for analysis (mbgl)	0.64		
75% effective depth (mbgl):	0.86	Elapsed time (mins):	#N/A
50% effective depth (mbgl):	1.07		
25% effective depth (mbgl):	1.29	Elapsed time (mins):	#N/A
Base of soakage zone (mbgl):	1.50		
Volume outflow between 75% and 25% effective depth (m^3):			
Mean surface area of outflow (m^2):		1.98	
(side area at 50% effective depth + base area)			
Time for outflow between 75% and 25% effective depth (mins):			

Soil infiltration rate (m/s):	**Test incomplete as 25% effective depth not achieved. Unable to reliably determine soil infiltration rate.**

Remarks Results processed following BRE 365 (2007).

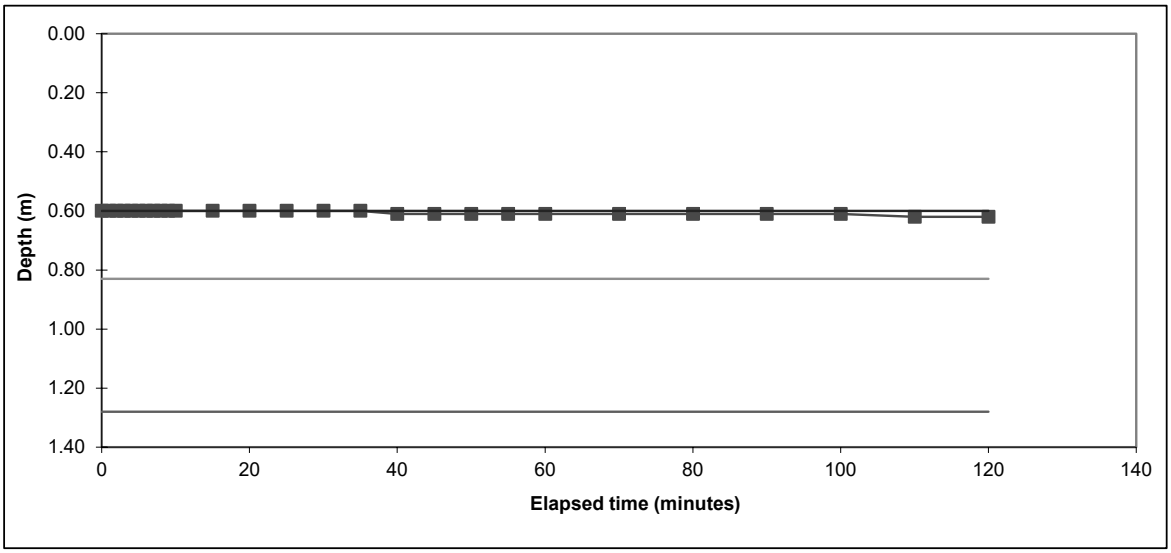
Client:	Lanmor Consulting	**TP1**
Site:	Land at Station Road	

Your Environment

Soakaway Test

Trial Pit No:	TP2	Test No:	1	Date:	07/02/2022
Length (m):	1.200		Datum Height:	0.00	m agl
Width (m):	0.40		Granular infill:	None	
Depth (m):	1.50		Porosity of infill:	1	(assumed)

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	0.600	30	0.600
1	0.600	35	0.600
2	0.600	40	0.610
3	0.600	45	0.610
4	0.600	50	0.610
5	0.600	55	0.610
6	0.600	60	0.610
7	0.600	70	0.610
8	0.600	80	0.610
9	0.600	90	0.610
10	0.600	100	0.610
15	0.600	110	0.620
20	0.600	120	0.620
25	0.600		



Start water depth for analysis (mbgl)	0.60		
75% effective depth (mbgl):	0.83	Elapsed time (mins):	#N/A
50% effective depth (mbgl):	1.05		
25% effective depth (mbgl):	1.28	Elapsed time (mins):	#N/A
Base of soakage zone (mbgl):	1.50		
Volume outflow between 75% and 25% effective depth (m^3):			
Mean surface area of outflow (m^2):		1.92	
(side area at 50% effective depth + base area)			
Time for outflow between 75% and 25% effective depth (mins):			

Soil infiltration rate (m/s):	**Test incomplete as 25% effective depth not achieved. Unable to reliably determine soil infiltration rate.**

Remarks Results processed following BRE 365 (2007).

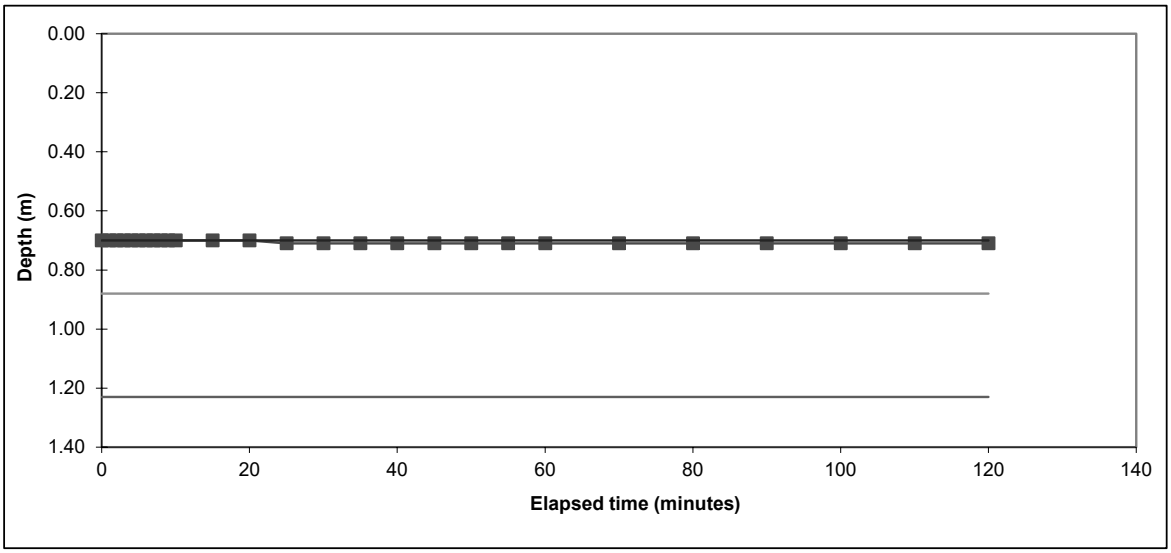
Client:	Lanmor Consulting	**TP2**
Site:	Land at Station Road	

Your Environment

Soakaway Test

Trial Pit No:	TP3	Test No:	1	Date:	07/02/2022
Length (m):	1.200		Datum Height:	0.00	m agl
Width (m):	0.40		Granular infill:	None	
Depth (m):	1.40		Porosity of infill:	1	(assumed)

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	0.700	30	0.710
1	0.700	35	0.710
2	0.700	40	0.710
3	0.700	45	0.710
4	0.700	50	0.710
5	0.700	55	0.710
6	0.700	60	0.710
7	0.700	70	0.710
8	0.700	80	0.710
9	0.700	90	0.710
10	0.700	100	0.710
15	0.700	110	0.710
20	0.700	120	0.710
25	0.710		



Start water depth for analysis (mbgl)	0.70		
75% effective depth (mbgl):	0.88	Elapsed time (mins):	#N/A
50% effective depth (mbgl):	1.05		
25% effective depth (mbgl):	1.23	Elapsed time (mins):	#N/A
Base of soakage zone (mbgl):	1.40		
Volume outflow between 75% and 25% effective depth (m^3):			
Mean surface area of outflow (m^2):		1.60	
(side area at 50% effective depth + base area)			
Time for outflow between 75% and 25% effective depth (mins):			

Soil infiltration rate (m/s):	**Test incomplete as 25% effective depth not achieved. Unable to reliably determine soil infiltration rate.**

Remarks Results processed following BRE 365 (2007).

Client:	Lanmor Consulting	**TP3**
Site:	Land at Station Road	

Appendix D

YEX3560
TP01 Photos

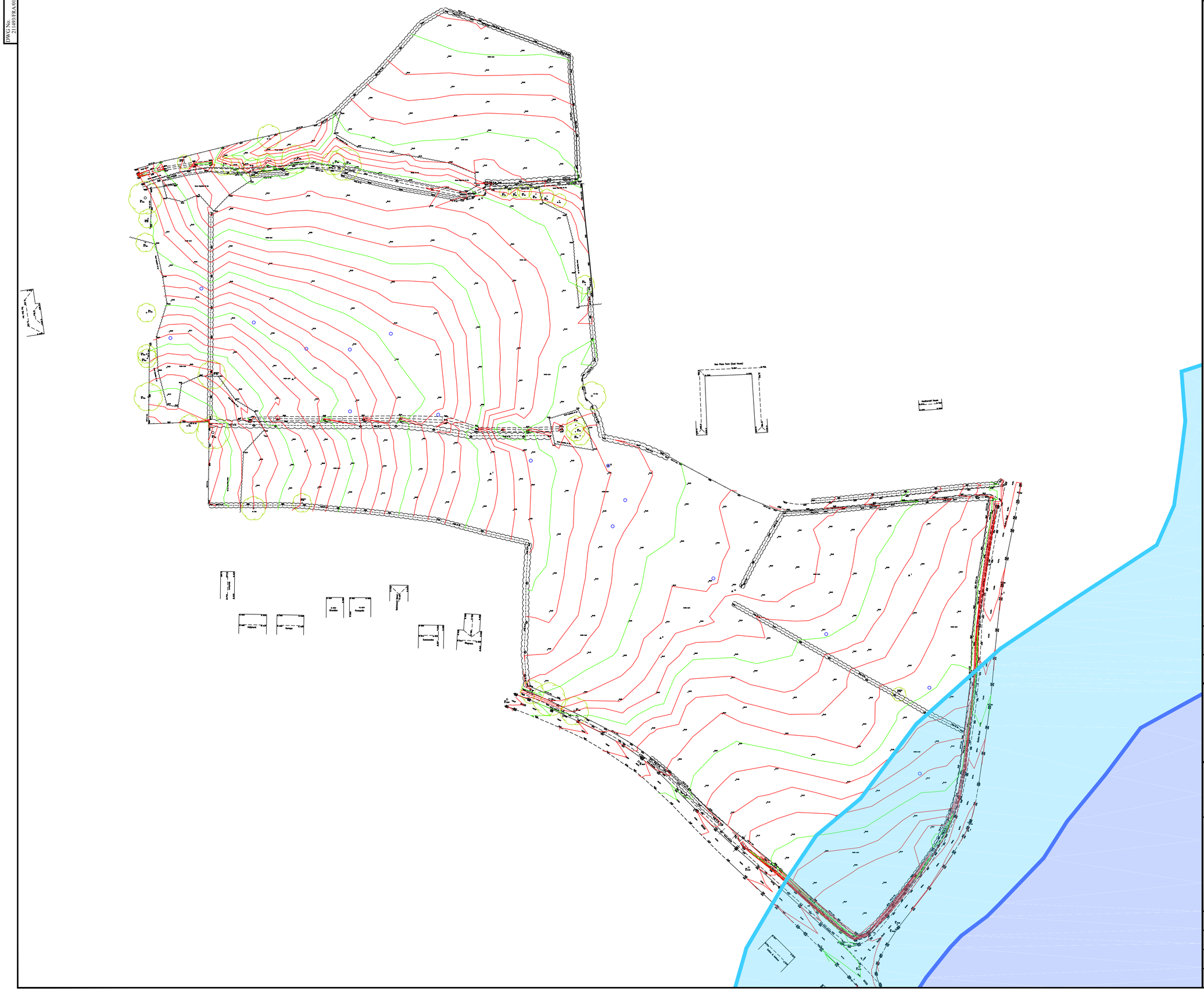
YEX3560
TP02 Photos

YEX3560
TP03 Photos

APPENDIX C

Drawing 211496/FRA/01 – Flood Zone 2 and 3 Extent (Topographical Survey)

DWG No.
211493/FRA/01



NOTES

Rev	Amendment	Drawn	Checked	Approved	Date

LANMOR Consulting
Civil Engineers & Transport Planning
Thorogood House, 34 Tolworth Close, Surbiton, Surrey, KT6 7EW
Telephone: 0208 339 7899 Fax: 0208 339 7898
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www.lanmor.co.uk

Woolbro Group and Morris Investment

Station Road
Lingfield

Flood Zone Extents
Topographical Survey

DRAWN MK	CHECKED KBL	APPROVED KBL	
DATE Mar-22	DATE Mar-22	DATE Mar-22	
SCALE 1:750	PRJ No. 211493	SIZE A1	REV -
DWG No. 211493/FRA/01			

Drawing 211496/FRA/02 – Flood Zone 2 and 3 Extent (Proposed Masterplan)

DWG No. 211493/FRA/02

NOTES

Key:

- Flood Zone 2
- Flood Zone 3

Rev	Amendment	Drawn	Checked	Approved	Date

LANMOR Consulting
Civil Engineers & Transport Planning

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www.lanmor.co.uk

Woolbro Group and Morris Investment

Station Road
Lingfield

Flood Zone Extents
Proposed Masterplan

DRAWN	MK	CHECKED	KBL	APPROVED	KBL
DATE	Mar-22	DATE	Mar-22	DATE	Mar-22
SCALE	1:750	PRJ No.	211493	SIZE	REV
DWG No.	211493/FRA/02			A1	-

APPENDIX D

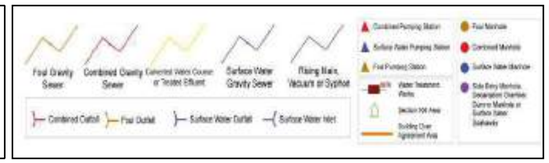
Southern Water Sewer Records

(c) Crown copyright and database rights 2022 Ordnance Survey 100031673 | Date: 14/02/22 | Scale: 1:1250 | Map Centre: 539185,143610 | Data updated: 17/01/22 | Our Ref: 781728 - 1 | Wastewater Plan A2

The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual positions should be determined on site. This plan is produced by Southern Water Services Ltd (c) Crown copyright and database rights 2022 Ordnance Survey 100031673 .This map is to be used for the purposes of viewing the location of Southern Water plant only. Any other uses of the map data or further copies is not permitted.

WARNING: BAC pipes are constructed of Bonded Asbestos Cement.

WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement.



robert.steventon@lanmor.co.uk

Station Road

WATER for LIFE from Southern Water

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
0501	F	58.63	0.00	
0502	F	56.89	55.14	
1501	F	55.27	53.57	
1502	F	53.44	51.67	
2401	F	52.39	50.47	
2402	F	51.56	49.88	
2804	F	49.92	0.00	
3301	F	50.34	0.00	
3401	F	50.27	0.00	
3402	F	50.36	0.00	
3403	F	51.06	49.21	
3501	F	51.11	0.00	
3502	F	51.89	0.00	
3601	F	52.04	0.00	
3602	F	51.97	0.00	
3701	F	51.75	0.00	
3702	F	51.45	0.00	
8401	F	67.70	66.02	
8402	F	67.85	66.18	
8403	F	68.02	66.64	
8404	F	68.17	66.87	
8502	F	67.34	64.90	
8503	F	65.41	63.81	
8505	F	66.20	64.75	
9401	F	66.12	63.70	
9501	F	64.39	62.22	
9502	F	62.75	60.59	
9601	F	63.09	60.09	
9602	F	61.92	59.54	
9701	F	62.67	61.06	
9702	F	61.32	59.04	
9703	F	60.66	58.41	
9705	F	0.00	0.00	
9801	F	60.08	57.58	

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Drawing 211493/DS/01 – Proposed Drainage Sketch

Woolbro Group and Morris Investment

Station Road, Lingfield

Drainage Sketch

SCALE	DRAWN BY	PRJ No.	DWG No.
NTS	RS	211493	211493/DS/01 Rev A

LANMOR Consulting
Civil Engineers & Transport Planning

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www.lanmor.co.uk

MicroDrainage Calculations – Permeable Paving

Cascade Summary of Results for PP1.srcx

Upstream Structures	Outflow To	Overflow To
(None)	TANK 3.srcx	(None)

Half Drain Time : 54 minutes.

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
15 min Summer	55.637	0.337	0.0	2.4	2.4	7.9	Flood Risk
30 min Summer	55.680	0.380	0.0	2.4	2.4	10.1	Flood Risk
60 min Summer	55.699	0.399	0.0	2.5	2.5	11.1	Flood Risk
120 min Summer	55.694	0.394	0.0	2.4	2.4	10.8	Flood Risk
180 min Summer	55.677	0.377	0.0	2.4	2.4	9.9	Flood Risk
240 min Summer	55.657	0.357	0.0	2.4	2.4	8.9	Flood Risk
360 min Summer	55.616	0.316	0.0	2.4	2.4	6.9	Flood Risk
480 min Summer	55.565	0.265	0.0	2.4	2.4	4.9	O K
600 min Summer	55.516	0.216	0.0	2.4	2.4	3.3	O K
720 min Summer	55.472	0.172	0.0	2.4	2.4	2.1	O K
960 min Summer	55.408	0.108	0.0	2.4	2.4	0.8	O K
1440 min Summer	55.376	0.076	0.0	1.9	1.9	0.4	O K
2160 min Summer	55.360	0.060	0.0	1.4	1.4	0.3	O K
2880 min Summer	55.352	0.052	0.0	1.1	1.1	0.2	O K
4320 min Summer	55.343	0.043	0.0	0.8	0.8	0.1	O K
5760 min Summer	55.338	0.038	0.0	0.6	0.6	0.1	O K
7200 min Summer	55.334	0.034	0.0	0.5	0.5	0.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	131.851	0.0	9.5	17
30 min Summer	88.566	0.0	13.2	31
60 min Summer	56.713	0.0	17.3	50
120 min Summer	35.004	0.0	21.6	84
180 min Summer	25.973	0.0	24.2	118
240 min Summer	20.877	0.0	26.0	152
360 min Summer	15.365	0.0	28.8	218
480 min Summer	12.341	0.0	30.9	280
600 min Summer	10.402	0.0	32.6	336
720 min Summer	9.042	0.0	34.0	390
960 min Summer	7.241	0.0	36.3	492
1440 min Summer	5.284	0.0	39.6	734
2160 min Summer	3.848	0.0	43.1	1080
2880 min Summer	3.068	0.0	45.5	1468
4320 min Summer	2.226	0.0	49.0	2164
5760 min Summer	1.771	0.0	51.4	2856
7200 min Summer	1.483	0.0	53.2	3544

Cascade Summary of Results for PP1.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
8640 min Summer	55.332	0.032	0.0	0.5	0.5	0.1	O K
10080 min Summer	55.330	0.030	0.0	0.4	0.4	0.1	O K
15 min Winter	55.662	0.362	0.0	2.4	2.4	9.1	Flood Risk
30 min Winter	55.710	0.410	0.0	2.5	2.5	11.7	Flood Risk
60 min Winter	55.732	0.432	0.0	2.5	2.5	12.9	Flood Risk
120 min Winter	55.723	0.423	0.0	2.5	2.5	12.4	Flood Risk
180 min Winter	55.698	0.398	0.0	2.4	2.4	11.0	Flood Risk
240 min Winter	55.667	0.367	0.0	2.4	2.4	9.4	Flood Risk
360 min Winter	55.601	0.301	0.0	2.4	2.4	6.3	Flood Risk
480 min Winter	55.512	0.212	0.0	2.4	2.4	3.1	O K
600 min Winter	55.432	0.132	0.0	2.4	2.4	1.2	O K
720 min Winter	55.394	0.094	0.0	2.3	2.3	0.6	O K
960 min Winter	55.376	0.076	0.0	1.9	1.9	0.4	O K
1440 min Winter	55.360	0.060	0.0	1.4	1.4	0.2	O K
2160 min Winter	55.349	0.049	0.0	1.0	1.0	0.2	O K
2880 min Winter	55.343	0.043	0.0	0.8	0.8	0.1	O K
4320 min Winter	55.336	0.036	0.0	0.6	0.6	0.1	O K
5760 min Winter	55.331	0.031	0.0	0.5	0.5	0.1	O K
7200 min Winter	55.329	0.029	0.0	0.4	0.4	0.1	O K
8640 min Winter	55.326	0.026	0.0	0.3	0.3	0.0	O K
10080 min Winter	55.325	0.025	0.0	0.3	0.3	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.284	0.0	54.6	4392
10080 min Summer	1.137	0.0	55.8	5112
15 min Winter	131.851	0.0	10.8	17
30 min Winter	88.566	0.0	15.0	31
60 min Winter	56.713	0.0	19.5	56
120 min Winter	35.004	0.0	24.4	90
180 min Winter	25.973	0.0	27.3	128
240 min Winter	20.877	0.0	29.3	164
360 min Winter	15.365	0.0	32.5	234
480 min Winter	12.341	0.0	34.8	288
600 min Winter	10.402	0.0	36.7	332
720 min Winter	9.042	0.0	38.3	370
960 min Winter	7.241	0.0	40.9	490
1440 min Winter	5.284	0.0	44.6	726
2160 min Winter	3.848	0.0	48.6	1068
2880 min Winter	3.068	0.0	51.4	1460
4320 min Winter	2.226	0.0	55.4	2180
5760 min Winter	1.771	0.0	58.1	2840
7200 min Winter	1.483	0.0	60.3	3640
8640 min Winter	1.284	0.0	62.0	4360
10080 min Winter	1.137	0.0	63.4	5008

Cascade Rainfall Details for PP1.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)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.044

Time (mins) From:	To:	Area (ha)
0	4	0.044

Cascade Model Details for PP1.srcx

Storage is Online Cover Level (m) 55.900

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	11.6
Membrane Percolation (mm/hr)	1000	Length (m)	24.0
Max Percolation (l/s)	77.3	Slope (1:X)	40.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	55.300	Cap Volume Depth (m)	0.400

Hydro-Brake Optimum® Outflow Control

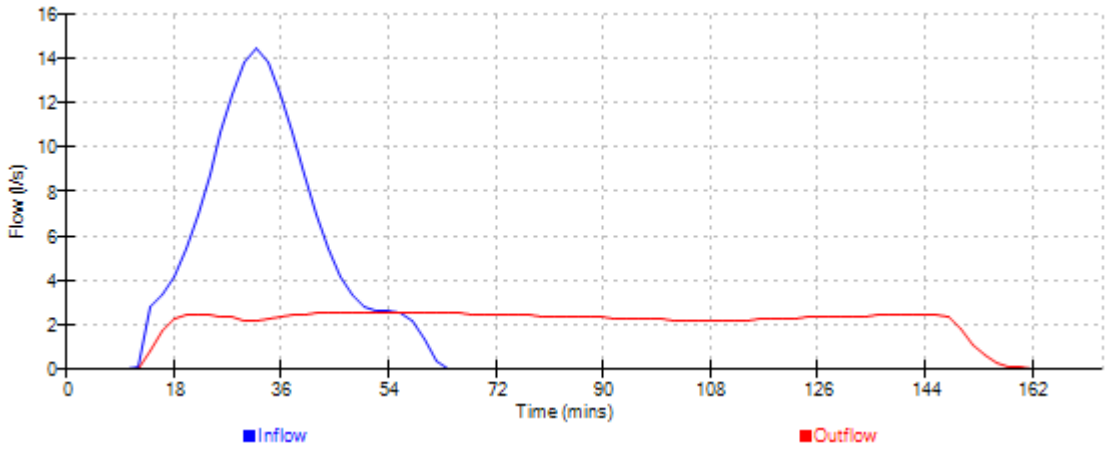
Unit Reference	MD-SHE-0083-2500-0400-2500
Design Head (m)	0.400
Design Flow (l/s)	2.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	83
Invert Level (m)	55.300
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

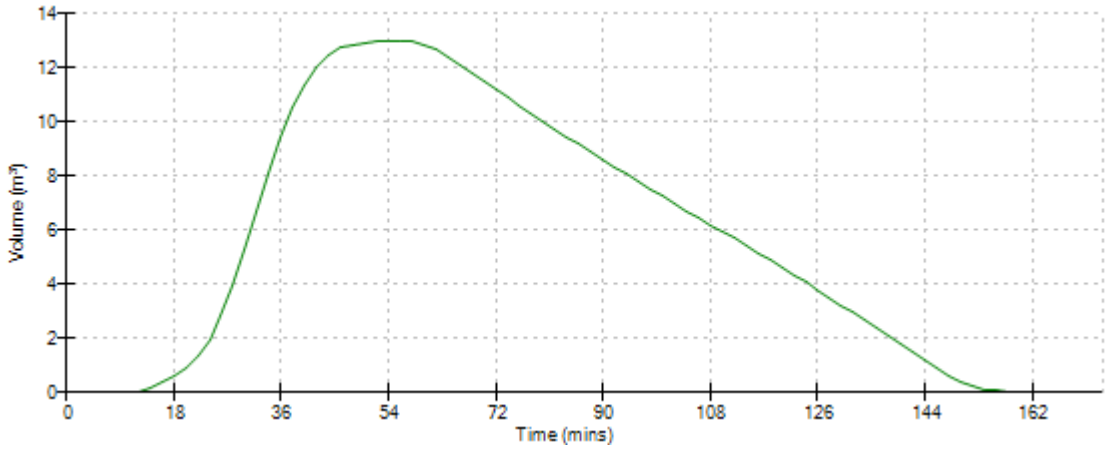
Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.400	2.5
Flush-Flo™	0.131	2.4
Kick-Flo®	0.290	2.1
Mean Flow over Head Range	-	2.0

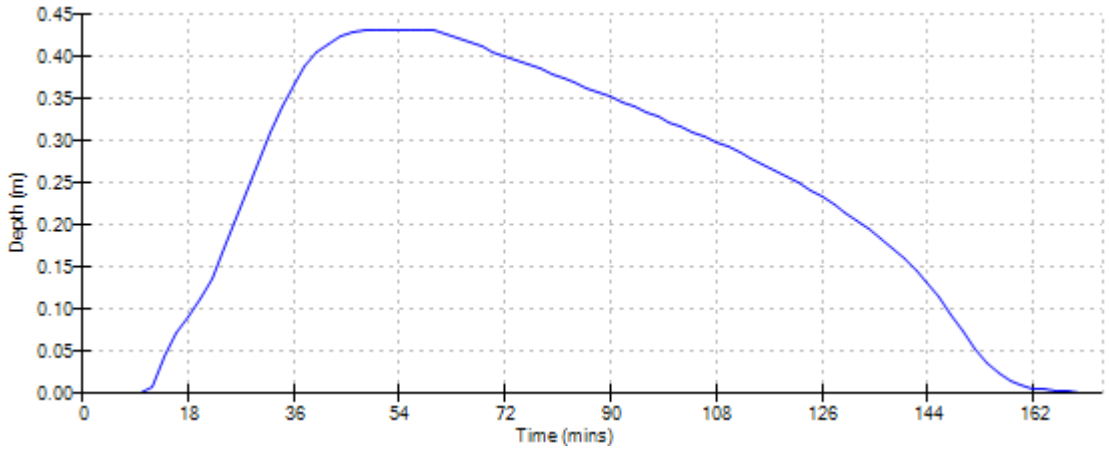
The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake Optimum® as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.4	1.200	4.1	3.000	6.2	7.000	9.4
0.200	2.4	1.400	4.4	3.500	6.7	7.500	9.8
0.300	2.2	1.600	4.6	4.000	7.1	8.000	10.1
0.400	2.5	1.800	4.9	4.500	7.5	8.500	10.4
0.500	2.7	2.000	5.2	5.000	8.0	9.000	10.7
0.600	3.0	2.200	5.4	5.500	8.3	9.500	11.0
0.800	3.4	2.400	5.6	6.000	8.7		
1.000	3.7	2.600	5.8	6.500	9.1		

Cascade Event: 60 min Winter for PP1.srcx







Cascade Summary of Results for PP2.srcx

Upstream Structures	Outflow To	Overflow To
(None)	POND.srcx	(None)

Half Drain Time : 105 minutes.

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
15 min Summer	53.514	0.314	0.0	4.9	4.9	34.6	Flood Risk
30 min Summer	53.581	0.381	0.0	4.9	4.9	45.2	Flood Risk
60 min Summer	53.633	0.433	0.0	5.1	5.1	53.2	Flood Risk
120 min Summer	53.654	0.454	0.0	5.2	5.2	55.8	Flood Risk
180 min Summer	53.645	0.445	0.0	5.2	5.2	54.7	Flood Risk
240 min Summer	53.630	0.430	0.0	5.1	5.1	52.7	Flood Risk
360 min Summer	53.602	0.402	0.0	5.0	5.0	48.6	Flood Risk
480 min Summer	53.575	0.375	0.0	4.9	4.9	44.4	Flood Risk
600 min Summer	53.549	0.349	0.0	4.9	4.9	40.2	Flood Risk
720 min Summer	53.523	0.323	0.0	4.9	4.9	36.0	Flood Risk
960 min Summer	53.467	0.267	0.0	4.9	4.9	27.1	O K
1440 min Summer	53.388	0.188	0.0	4.9	4.9	14.5	O K
2160 min Summer	53.323	0.123	0.0	4.8	4.8	6.2	O K
2880 min Summer	53.302	0.102	0.0	4.0	4.0	4.3	O K
4320 min Summer	53.281	0.081	0.0	3.0	3.0	2.7	O K
5760 min Summer	53.270	0.070	0.0	2.4	2.4	2.0	O K
7200 min Summer	53.263	0.063	0.0	2.0	2.0	1.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	131.851	0.0	38.1	18
30 min Summer	88.566	0.0	52.1	32
60 min Summer	56.713	0.0	67.5	60
120 min Summer	35.004	0.0	83.8	100
180 min Summer	25.973	0.0	93.6	132
240 min Summer	20.877	0.0	100.4	166
360 min Summer	15.365	0.0	111.0	236
480 min Summer	12.341	0.0	119.0	306
600 min Summer	10.402	0.0	125.4	374
720 min Summer	9.042	0.0	130.8	442
960 min Summer	7.241	0.0	139.6	562
1440 min Summer	5.284	0.0	152.7	792
2160 min Summer	3.848	0.0	166.4	1104
2880 min Summer	3.068	0.0	176.4	1468
4320 min Summer	2.226	0.0	190.9	2200
5760 min Summer	1.771	0.0	201.3	2936
7200 min Summer	1.483	0.0	209.6	3624

Cascade Summary of Results for PP2.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
8640 min Summer	53.258	0.058	0.0	1.7	1.7	1.4	O K
10080 min Summer	53.254	0.054	0.0	1.5	1.5	1.2	O K
15 min Winter	53.544	0.344	0.0	4.9	4.9	39.4	Flood Risk
30 min Winter	53.622	0.422	0.0	5.1	5.1	51.6	Flood Risk
60 min Winter	53.712	0.512	0.0	5.5	5.5	61.2	Flood Risk
120 min Winter	53.800	0.600	0.0	6.0	6.0	64.1	FLOOD
180 min Winter	53.746	0.546	0.0	5.7	5.7	63.0	Flood Risk
240 min Winter	53.701	0.501	0.0	5.5	5.5	60.3	Flood Risk
360 min Winter	53.641	0.441	0.0	5.2	5.2	54.2	Flood Risk
480 min Winter	53.596	0.396	0.0	4.9	4.9	47.7	Flood Risk
600 min Winter	53.556	0.356	0.0	4.9	4.9	41.2	Flood Risk
720 min Winter	53.514	0.314	0.0	4.9	4.9	34.6	Flood Risk
960 min Winter	53.429	0.229	0.0	4.9	4.9	21.0	O K
1440 min Winter	53.328	0.128	0.0	4.9	4.9	6.7	O K
2160 min Winter	53.295	0.095	0.0	3.7	3.7	3.7	O K
2880 min Winter	53.281	0.081	0.0	3.0	3.0	2.7	O K
4320 min Winter	53.266	0.066	0.0	2.1	2.1	1.8	O K
5760 min Winter	53.258	0.058	0.0	1.7	1.7	1.4	O K
7200 min Winter	53.252	0.052	0.0	1.4	1.4	1.1	O K
8640 min Winter	53.248	0.048	0.0	1.2	1.2	0.9	O K
10080 min Winter	53.245	0.045	0.0	1.1	1.1	0.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.284	0.0	216.6	4384
10080 min Summer	1.137	0.0	222.5	5048
15 min Winter	131.851	0.0	43.0	18
30 min Winter	88.566	0.0	58.7	32
60 min Winter	56.713	0.0	75.9	60
120 min Winter	35.004	0.3	94.2	108
180 min Winter	25.973	0.0	105.1	140
240 min Winter	20.877	0.0	112.8	180
360 min Winter	15.365	0.0	124.7	256
480 min Winter	12.341	0.0	133.6	330
600 min Winter	10.402	0.0	140.9	404
720 min Winter	9.042	0.0	146.9	476
960 min Winter	7.241	0.0	156.8	588
1440 min Winter	5.284	0.0	171.5	766
2160 min Winter	3.848	0.0	186.9	1104
2880 min Winter	3.068	0.0	198.3	1444
4320 min Winter	2.226	0.0	214.7	2200
5760 min Winter	1.771	0.0	226.5	2936
7200 min Winter	1.483	0.0	236.1	3664
8640 min Winter	1.284	0.0	244.1	4400
10080 min Winter	1.137	0.0	251.0	4984

Cascade Rainfall Details for PP2.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)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.165

Time (mins) From:	To:	Area (ha)
0	4	0.165

Cascade Model Details for PP2.srcx

Storage is Online Cover Level (m) 53.800

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	27.3
Membrane Percolation (mm/hr)	1000	Length (m)	19.5
Max Percolation (l/s)	147.9	Slope (1:X)	100.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	53.200	Cap Volume Depth (m)	0.400

Hydro-Brake Optimum® Outflow Control

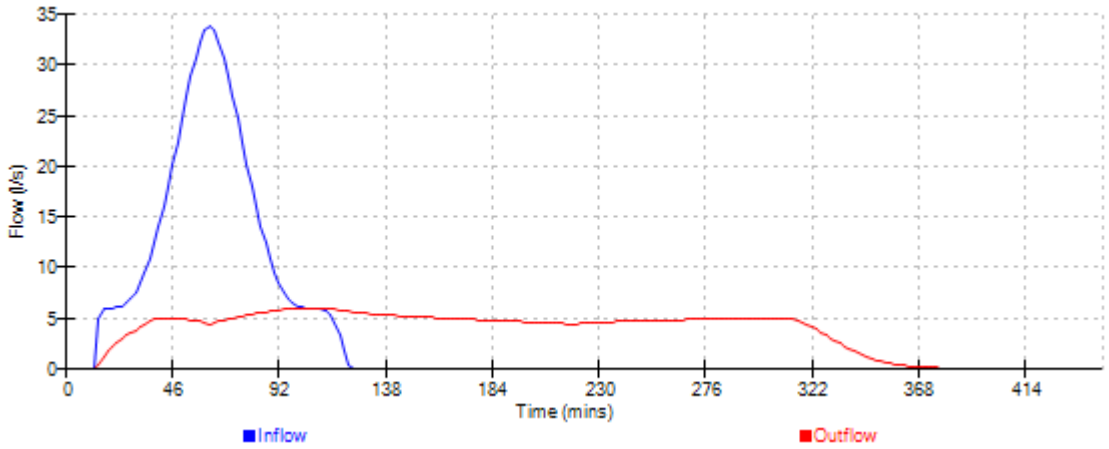
Unit Reference	MD-SHE-0113-5000-0400-5000
Design Head (m)	0.400
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	113
Invert Level (m)	53.200
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

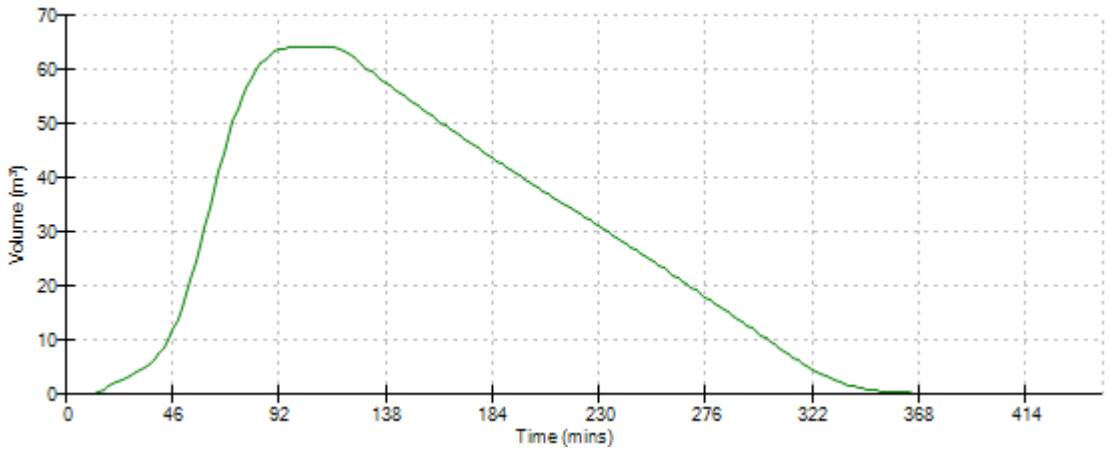
Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.400	4.9
Flush-Flo™	0.168	4.9
Kick-Flo®	0.310	4.4
Mean Flow over Head Range	-	3.9

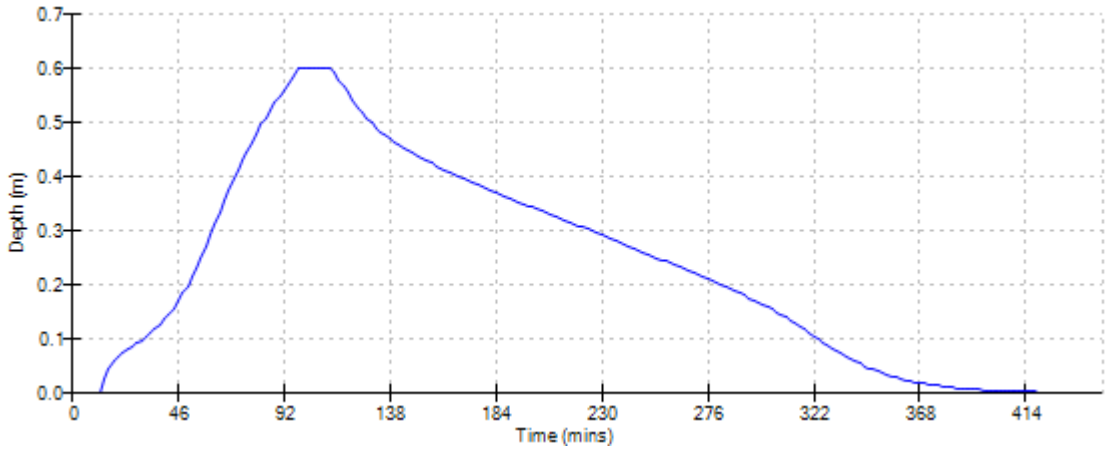
The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake Optimum® as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.9	1.200	8.3	3.000	12.8	7.000	19.3
0.200	4.9	1.400	8.9	3.500	13.7	7.500	20.0
0.300	4.5	1.600	9.5	4.000	14.6	8.000	20.6
0.400	4.9	1.800	10.0	4.500	15.4	8.500	21.3
0.500	5.5	2.000	10.5	5.000	16.3	9.000	21.9
0.600	6.0	2.200	11.0	5.500	17.1	9.500	22.5
0.800	6.8	2.400	11.5	6.000	17.8		
1.000	7.6	2.600	11.9	6.500	18.6		

Cascade Event: 120 min Winter for PP2.srcx







MicroDrainage Calculations – Swales

Cascade Summary of Results for SWALE 1.srcx

Upstream Structures	Outflow To	Overflow To
TANK 2.srcx	POND.srcx	(None)

Half Drain Time : 345 minutes.

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
15 min Summer	54.547	0.507	0.0	5.0	5.0	74.5	O K
30 min Summer	54.611	0.571	0.0	5.0	5.0	98.9	O K
60 min Summer	54.667	0.627	0.0	5.0	5.0	123.5	O K
120 min Summer	54.713	0.673	0.0	5.0	5.0	145.6	Flood Risk
180 min Summer	54.732	0.692	0.0	5.0	5.0	155.0	Flood Risk
240 min Summer	54.740	0.700	0.0	5.0	5.0	159.3	Flood Risk
360 min Summer	54.747	0.707	0.0	5.0	5.0	162.8	Flood Risk
480 min Summer	54.747	0.707	0.0	5.0	5.0	162.6	Flood Risk
600 min Summer	54.743	0.703	0.0	5.0	5.0	160.5	Flood Risk
720 min Summer	54.738	0.698	0.0	5.0	5.0	158.2	Flood Risk
960 min Summer	54.729	0.689	0.0	5.0	5.0	153.6	Flood Risk
1440 min Summer	54.712	0.672	0.0	5.0	5.0	144.8	Flood Risk
2160 min Summer	54.685	0.645	0.0	5.0	5.0	131.7	O K
2880 min Summer	54.657	0.617	0.0	5.0	5.0	118.8	O K
4320 min Summer	54.598	0.558	0.0	5.0	5.0	94.0	O K
5760 min Summer	54.516	0.476	0.0	5.0	5.0	64.0	O K
7200 min Summer	54.422	0.382	0.0	5.0	5.0	36.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	131.851	0.0	163.8	19
30 min Summer	88.566	0.0	220.1	34
60 min Summer	56.713	0.0	281.9	64
120 min Summer	35.004	0.0	348.0	122
180 min Summer	25.973	0.0	387.4	182
240 min Summer	20.877	0.0	415.1	242
360 min Summer	15.365	0.0	458.3	362
480 min Summer	12.341	0.0	490.8	480
600 min Summer	10.402	0.0	517.1	572
720 min Summer	9.042	0.0	539.4	622
960 min Summer	7.241	0.0	576.0	750
1440 min Summer	5.284	0.0	630.3	1012
2160 min Summer	3.848	0.0	688.7	1428
2880 min Summer	3.068	0.0	732.3	1848
4320 min Summer	2.226	0.0	796.8	2680
5760 min Summer	1.771	0.0	844.4	3464
7200 min Summer	1.483	0.0	884.4	4040

Cascade Summary of Results for SWALE 1.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
8640 min Summer	54.337	0.297	0.0	5.0	5.0	19.8	O K
10080 min Summer	54.259	0.219	0.0	5.0	5.0	9.5	O K
15 min Winter	54.573	0.533	0.0	5.0	5.0	83.9	O K
30 min Winter	54.640	0.600	0.0	5.0	5.0	111.5	O K
60 min Winter	54.702	0.662	0.0	5.0	5.0	139.8	Flood Risk
120 min Winter	54.753	0.713	0.0	5.0	5.0	165.9	Flood Risk
180 min Winter	54.775	0.735	0.0	5.0	5.0	178.0	Flood Risk
240 min Winter	54.786	0.746	0.0	5.0	5.0	184.0	Flood Risk
360 min Winter	54.797	0.757	0.0	5.0	5.0	189.9	Flood Risk
480 min Winter	54.799	0.759	0.0	5.0	5.0	190.9	Flood Risk
600 min Winter	54.796	0.756	0.0	5.0	5.0	189.6	Flood Risk
720 min Winter	54.792	0.752	0.0	5.0	5.0	187.1	Flood Risk
960 min Winter	54.780	0.740	0.0	5.0	5.0	180.6	Flood Risk
1440 min Winter	54.759	0.719	0.0	5.0	5.0	169.1	Flood Risk
2160 min Winter	54.722	0.682	0.0	5.0	5.0	149.6	Flood Risk
2880 min Winter	54.681	0.641	0.0	5.0	5.0	130.0	O K
4320 min Winter	54.591	0.551	0.0	5.0	5.0	91.1	O K
5760 min Winter	54.425	0.385	0.0	5.0	5.0	37.5	O K
7200 min Winter	54.258	0.218	0.0	5.0	5.0	9.4	O K
8640 min Winter	54.157	0.117	0.0	4.8	4.8	2.3	O K
10080 min Winter	54.119	0.079	0.0	4.4	4.4	0.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.284	0.0	919.1	4672
10080 min Summer	1.137	0.0	949.2	5248
15 min Winter	131.851	0.0	183.5	19
30 min Winter	88.566	0.0	246.5	33
60 min Winter	56.713	0.0	315.8	62
120 min Winter	35.004	0.0	389.8	120
180 min Winter	25.973	0.0	433.8	180
240 min Winter	20.877	0.0	465.1	238
360 min Winter	15.365	0.0	513.4	352
480 min Winter	12.341	0.0	549.8	464
600 min Winter	10.402	0.0	579.2	574
720 min Winter	9.042	0.0	604.2	680
960 min Winter	7.241	0.0	645.0	782
1440 min Winter	5.284	0.0	704.5	1082
2160 min Winter	3.848	0.0	771.3	1556
2880 min Winter	3.068	0.0	820.1	1992
4320 min Winter	2.226	0.0	892.5	2900
5760 min Winter	1.771	0.0	946.5	3512
7200 min Winter	1.483	0.0	990.4	3960
8640 min Winter	1.284	0.0	1028.4	4416
10080 min Winter	1.137	0.0	1063.3	5136

Cascade Rainfall Details for SWALE 1.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)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.313

Time (mins) From:	To:	Area (ha)
0	4	0.313

Cascade Model Details for SWALE 1.srcx

Storage is Online Cover Level (m) 55.000

Swale Structure

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	212.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	2.0
Safety Factor	2.0	Slope (1:X)	500.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	54.040	Cap Infiltration Depth (m)	0.000
Base Width (m)	0.5		

Hydro-Brake Optimum® Outflow Control

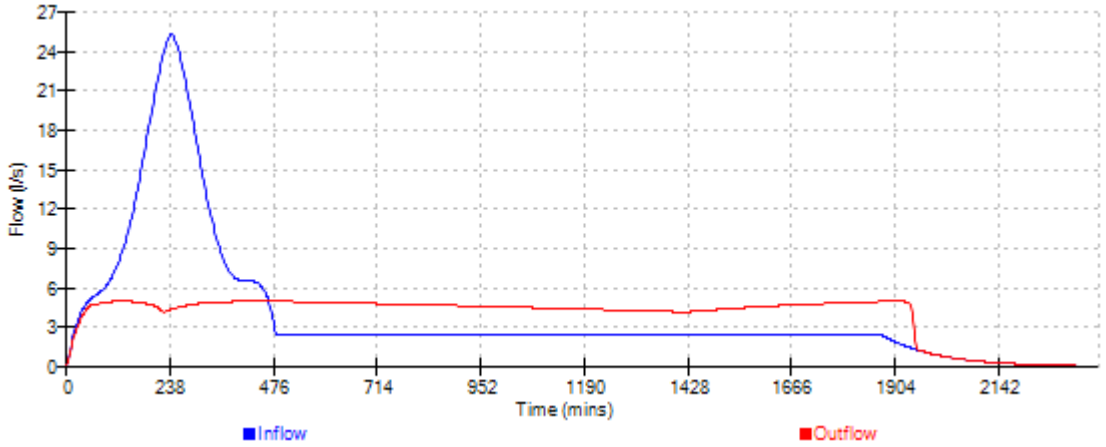
Unit Reference	MD-SHE-0109-5000-0800-5000
Design Head (m)	0.800
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	109
Invert Level (m)	54.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

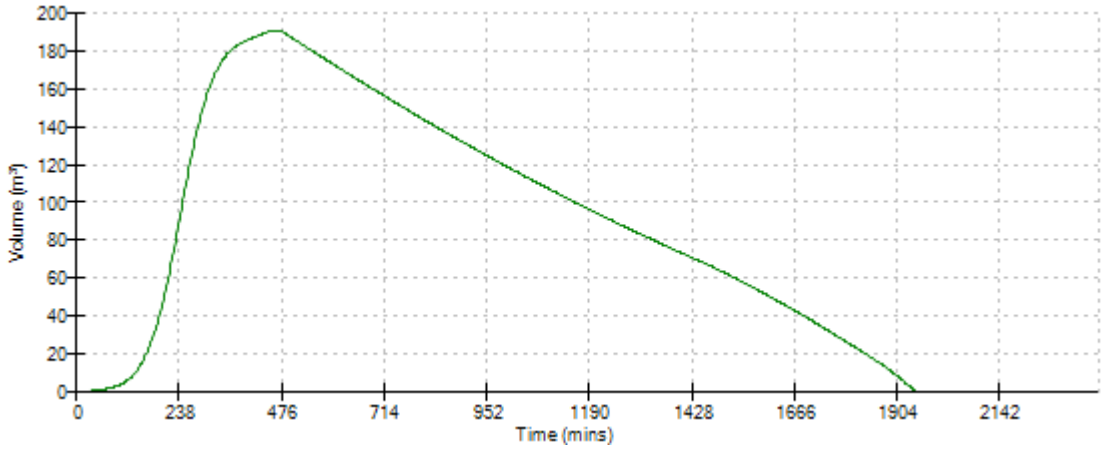
Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	5.0
Flush-Flo™	0.242	5.0
Kick-Flo®	0.537	4.2
Mean Flow over Head Range	-	4.3

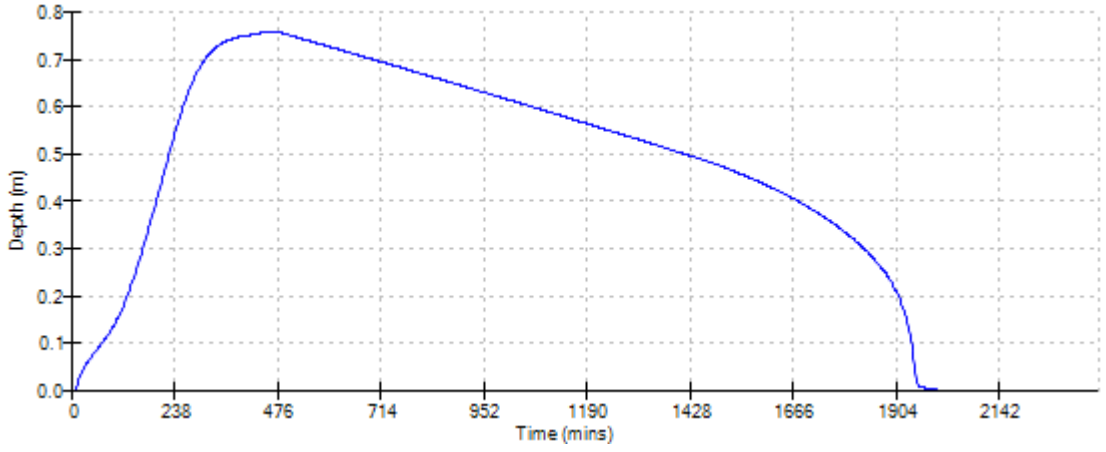
The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake Optimum® as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.7	1.200	6.0	3.000	9.3	7.000	13.9
0.200	5.0	1.400	6.5	3.500	10.0	7.500	14.4
0.300	5.0	1.600	6.9	4.000	10.6	8.000	14.8
0.400	4.8	1.800	7.3	4.500	11.3	8.500	15.2
0.500	4.5	2.000	7.7	5.000	11.8	9.000	15.7
0.600	4.4	2.200	8.0	5.500	12.4	9.500	16.1
0.800	5.0	2.400	8.4	6.000	12.9		
1.000	5.5	2.600	8.7	6.500	13.4		

Cascade Event: 480 min Winter for SWALE 1.srcx







Cascade Summary of Results for SWALE 2.srcx

Upstream Structures	Outflow To	Overflow To
TANK 4.srcx TANK 5.srcx	POND.srcx	(None)

Half Drain Time : 0 minutes.

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
15 min Summer	50.446	0.326	0.0	158.4	158.4	2.4	Flood Risk
30 min Summer	50.419	0.299	0.0	139.1	139.1	1.9	Flood Risk
60 min Summer	50.366	0.246	0.0	103.8	103.8	1.2	O K
120 min Summer	50.310	0.190	0.0	70.7	70.7	0.6	O K
180 min Summer	50.282	0.162	0.0	55.4	55.4	0.4	O K
240 min Summer	50.262	0.142	0.0	45.7	45.7	0.3	O K
360 min Summer	50.239	0.119	0.0	34.9	34.9	0.2	O K
480 min Summer	50.225	0.105	0.0	29.1	29.1	0.2	O K
600 min Summer	50.216	0.096	0.0	25.4	25.4	0.1	O K
720 min Summer	50.210	0.090	0.0	23.1	23.1	0.1	O K
960 min Summer	50.200	0.080	0.0	19.2	19.2	0.1	O K
1440 min Summer	50.189	0.069	0.0	15.4	15.4	0.1	O K
2160 min Summer	50.180	0.060	0.0	12.4	12.4	0.1	O K
2880 min Summer	50.174	0.054	0.0	10.8	10.8	0.0	O K
4320 min Summer	50.165	0.045	0.0	8.2	8.2	0.0	O K
5760 min Summer	50.160	0.040	0.0	6.9	6.9	0.0	O K
7200 min Summer	50.156	0.036	0.0	5.8	5.8	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	131.851	0.0	112.2	10
30 min Summer	88.566	0.0	150.9	17
60 min Summer	56.713	0.0	193.4	32
120 min Summer	35.004	0.0	238.8	62
180 min Summer	25.973	0.0	265.7	92
240 min Summer	20.877	0.0	284.8	122
360 min Summer	15.365	0.0	314.5	182
480 min Summer	12.341	0.0	336.8	240
600 min Summer	10.402	0.0	354.8	300
720 min Summer	9.042	0.0	370.1	366
960 min Summer	7.241	0.0	395.2	480
1440 min Summer	5.284	0.0	432.6	712
2160 min Summer	3.848	0.0	472.4	1100
2880 min Summer	3.068	0.0	502.2	1452
4320 min Summer	2.226	0.0	546.2	2164
5760 min Summer	1.771	0.0	579.1	2936
7200 min Summer	1.483	0.0	606.6	3584

Cascade Summary of Results for SWALE 2.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
8640 min Summer	50.152	0.032	0.0	4.9	4.9	0.0	O K
10080 min Summer	50.151	0.031	0.0	4.6	4.6	0.0	O K
15 min Winter	50.445	0.325	0.0	158.0	158.0	2.4	Flood Risk
30 min Winter	50.394	0.274	0.0	122.4	122.4	1.6	O K
60 min Winter	50.332	0.212	0.0	83.3	83.3	0.8	O K
120 min Winter	50.279	0.159	0.0	53.9	53.9	0.4	O K
180 min Winter	50.253	0.133	0.0	41.4	41.4	0.3	O K
240 min Winter	50.238	0.118	0.0	34.4	34.4	0.2	O K
360 min Winter	50.219	0.099	0.0	26.4	26.4	0.2	O K
480 min Winter	50.208	0.088	0.0	22.3	22.3	0.1	O K
600 min Winter	50.201	0.081	0.0	19.7	19.7	0.1	O K
720 min Winter	50.196	0.076	0.0	17.9	17.9	0.1	O K
960 min Winter	50.189	0.069	0.0	15.4	15.4	0.1	O K
1440 min Winter	50.180	0.060	0.0	12.4	12.4	0.1	O K
2160 min Winter	50.173	0.053	0.0	10.3	10.3	0.0	O K
2880 min Winter	50.166	0.046	0.0	8.3	8.3	0.0	O K
4320 min Winter	50.158	0.038	0.0	6.2	6.2	0.0	O K
5760 min Winter	50.153	0.033	0.0	5.0	5.0	0.0	O K
7200 min Winter	50.149	0.029	0.0	4.2	4.2	0.0	O K
8640 min Winter	50.147	0.027	0.0	3.7	3.7	0.0	O K
10080 min Winter	50.144	0.024	0.0	3.2	3.2	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.284	0.0	629.9	4272
10080 min Summer	1.137	0.0	649.8	5112
15 min Winter	131.851	0.0	125.7	10
30 min Winter	88.566	0.0	169.0	17
60 min Winter	56.713	0.0	216.6	32
120 min Winter	35.004	0.0	267.4	60
180 min Winter	25.973	0.0	297.7	90
240 min Winter	20.877	0.0	319.0	120
360 min Winter	15.365	0.0	352.2	176
480 min Winter	12.341	0.0	377.2	236
600 min Winter	10.402	0.0	397.4	308
720 min Winter	9.042	0.0	414.5	354
960 min Winter	7.241	0.0	442.6	486
1440 min Winter	5.284	0.0	484.5	680
2160 min Winter	3.848	0.0	529.1	1172
2880 min Winter	3.068	0.0	562.6	1484
4320 min Winter	2.226	0.0	612.1	2092
5760 min Winter	1.771	0.0	648.6	3048
7200 min Winter	1.483	0.0	679.4	3520
8640 min Winter	1.284	0.0	705.7	4408
10080 min Winter	1.137	0.0	727.9	4976

Cascade Rainfall Details for SWALE 2.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)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.240

Time (mins) From:	To:	Area (ha)
0	4	0.240

Cascade Model Details for SWALE 2.srcx

Storage is Online Cover Level (m) 50.700

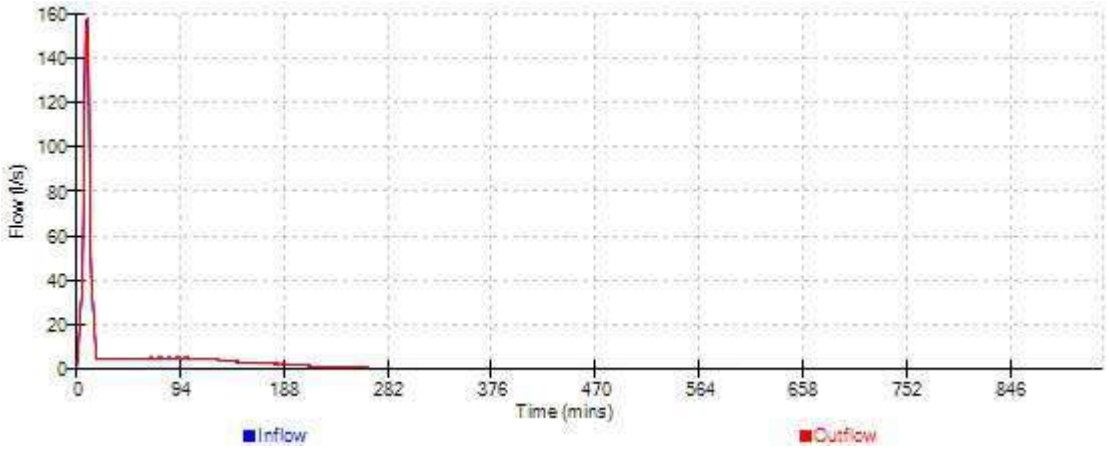
Swale Structure

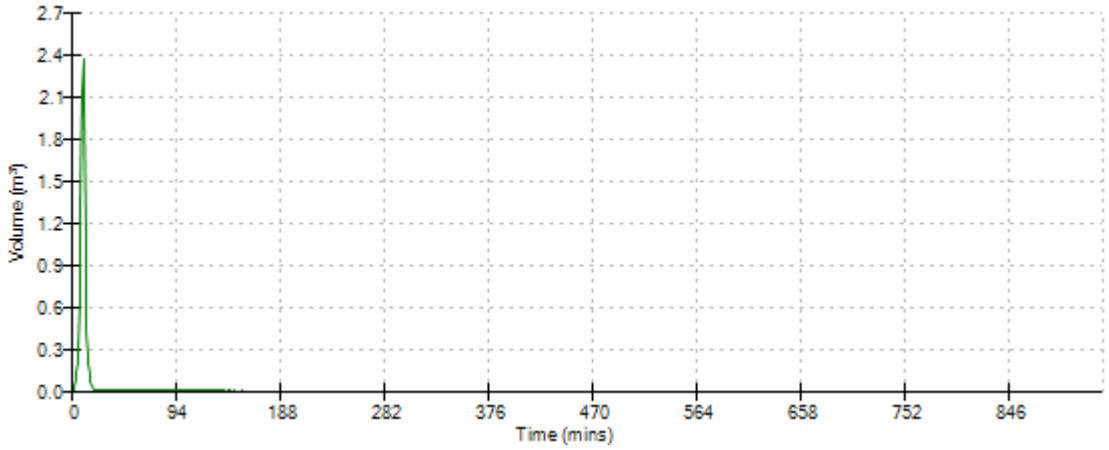
Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	82.1
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	2.0
Safety Factor	2.0	Slope (1:X)	48.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	50.120	Cap Infiltration Depth (m)	0.000
Base Width (m)	0.5		

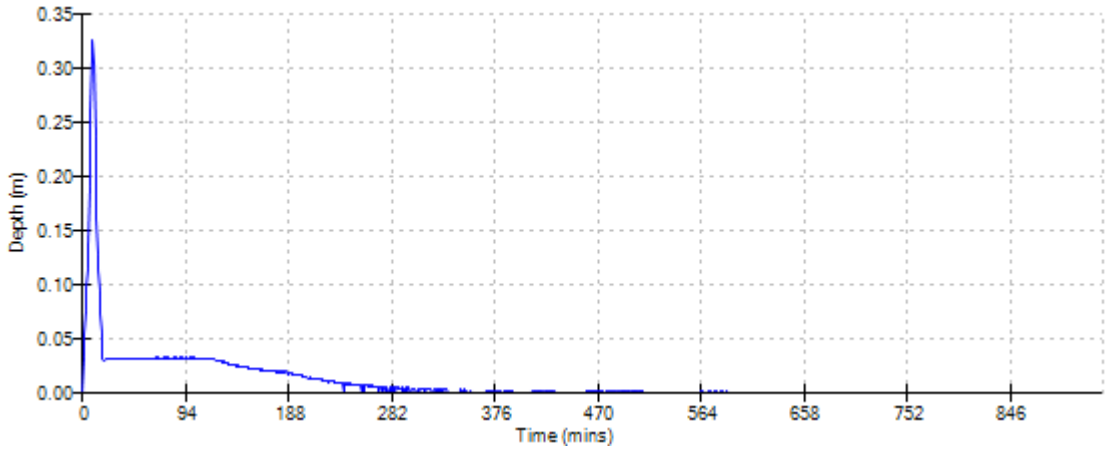
Weir Outflow Control

Discharge Coef 0.544 Width (m) 0.500 Invert Level (m) 50.120

Cascade Event: 15 min Summer for SWALE 2.srcx







MicroDrainage Calculations – Attenuation Tanks

Cascade Summary of Results for TANK 1.srcx

Upstream Structures	Outflow To	Overflow To
(None)	POND.srcx	(None)

Half Drain Time : 1313 minutes.

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
15 min Summer	55.990	0.390	0.0	2.3	2.3	126.8	O K
30 min Summer	56.121	0.521	0.0	2.3	2.3	169.4	O K
60 min Summer	56.261	0.661	0.0	2.3	2.3	215.0	O K
120 min Summer	56.401	0.801	0.0	2.3	2.3	260.5	O K
180 min Summer	56.475	0.875	0.0	2.3	2.3	284.7	O K
240 min Summer	56.521	0.921	0.0	2.3	2.3	299.7	O K
360 min Summer	56.583	0.983	0.0	2.3	2.3	319.8	O K
480 min Summer	56.618	1.018	0.0	2.3	2.3	331.2	O K
600 min Summer	56.638	1.038	0.0	2.3	2.3	337.9	O K
720 min Summer	56.649	1.049	0.0	2.3	2.3	341.3	O K
960 min Summer	56.652	1.052	0.0	2.3	2.3	342.3	O K
1440 min Summer	56.629	1.029	0.0	2.3	2.3	334.7	O K
2160 min Summer	56.586	0.986	0.0	2.3	2.3	320.9	O K
2880 min Summer	56.542	0.942	0.0	2.3	2.3	306.6	O K
4320 min Summer	56.457	0.857	0.0	2.3	2.3	278.7	O K
5760 min Summer	56.374	0.774	0.0	2.3	2.3	251.8	O K
7200 min Summer	56.292	0.692	0.0	2.3	2.3	225.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	131.851	0.0	123.3	19
30 min Summer	88.566	0.0	163.3	34
60 min Summer	56.713	0.0	218.5	64
120 min Summer	35.004	0.0	269.2	124
180 min Summer	25.973	0.0	298.7	184
240 min Summer	20.877	0.0	319.0	242
360 min Summer	15.365	0.0	347.5	362
480 min Summer	12.341	0.0	361.5	482
600 min Summer	10.402	0.0	363.8	602
720 min Summer	9.042	0.0	362.7	722
960 min Summer	7.241	0.0	357.7	960
1440 min Summer	5.284	0.0	345.0	1226
2160 min Summer	3.848	0.0	537.7	1600
2880 min Summer	3.068	0.0	570.8	2016
4320 min Summer	2.226	0.0	608.1	2852
5760 min Summer	1.771	0.0	662.2	3688
7200 min Summer	1.483	0.0	693.4	4536

Cascade Summary of Results for TANK 1.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
8640 min Summer	56.197	0.597	0.0	2.3	2.3	194.2	O K
10080 min Summer	56.112	0.512	0.0	2.3	2.3	166.7	O K
15 min Winter	56.037	0.437	0.0	2.3	2.3	142.2	O K
30 min Winter	56.184	0.584	0.0	2.3	2.3	190.1	O K
60 min Winter	56.342	0.742	0.0	2.3	2.3	241.4	O K
120 min Winter	56.500	0.900	0.0	2.3	2.3	293.0	O K
180 min Winter	56.586	0.986	0.0	2.3	2.3	320.7	O K
240 min Winter	56.639	1.039	0.0	2.3	2.3	338.1	O K
360 min Winter	56.712	1.112	0.0	2.4	2.4	361.9	O K
480 min Winter	56.756	1.156	0.0	2.5	2.5	376.2	O K
600 min Winter	56.783	1.183	0.0	2.5	2.5	385.0	O K
720 min Winter	56.800	1.200	0.0	2.5	2.5	390.3	O K
960 min Winter	57.394	1.794	0.0	3.0	3.0	393.1	Flood Risk
1440 min Winter	56.793	1.193	0.0	2.5	2.5	388.2	O K
2160 min Winter	56.738	1.138	0.0	2.4	2.4	370.2	O K
2880 min Winter	56.679	1.079	0.0	2.4	2.4	351.2	O K
4320 min Winter	56.555	0.955	0.0	2.3	2.3	310.8	O K
5760 min Winter	56.432	0.832	0.0	2.3	2.3	270.7	O K
7200 min Winter	56.308	0.708	0.0	2.3	2.3	230.5	O K
8640 min Winter	56.155	0.555	0.0	2.3	2.3	180.6	O K
10080 min Winter	56.036	0.436	0.0	2.3	2.3	141.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.284	0.0	720.1	5272
10080 min Summer	1.137	0.0	742.9	5952
15 min Winter	131.851	0.0	137.7	19
30 min Winter	88.566	0.0	178.9	33
60 min Winter	56.713	0.0	244.6	64
120 min Winter	35.004	0.0	300.6	122
180 min Winter	25.973	0.0	332.4	180
240 min Winter	20.877	0.0	352.4	240
360 min Winter	15.365	0.0	369.6	356
480 min Winter	12.341	0.0	371.2	472
600 min Winter	10.402	0.0	370.2	588
720 min Winter	9.042	0.0	368.5	702
960 min Winter	7.241	0.0	366.4	914
1440 min Winter	5.284	0.0	357.8	1354
2160 min Winter	3.848	0.0	601.7	1688
2880 min Winter	3.068	0.0	637.7	2160
4320 min Winter	2.226	0.0	646.4	3072
5760 min Winter	1.771	0.0	741.7	3984
7200 min Winter	1.483	0.0	776.6	4896
8640 min Winter	1.284	0.0	806.7	5616
10080 min Winter	1.137	0.0	832.4	6248

Cascade Rainfall Details for TANK 1.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)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.520

Time (mins) From:	To:	Area (ha)
0	4	0.520

Cascade Model Details for TANK 1.srcx

Storage is Online Cover Level (m) 57.600

Cellular Storage Structure

Invert Level (m) 55.600 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	342.5	0.0	1.201	4.5	0.0
1.200	342.5	0.0			

Hydro-Brake Optimum® Outflow Control

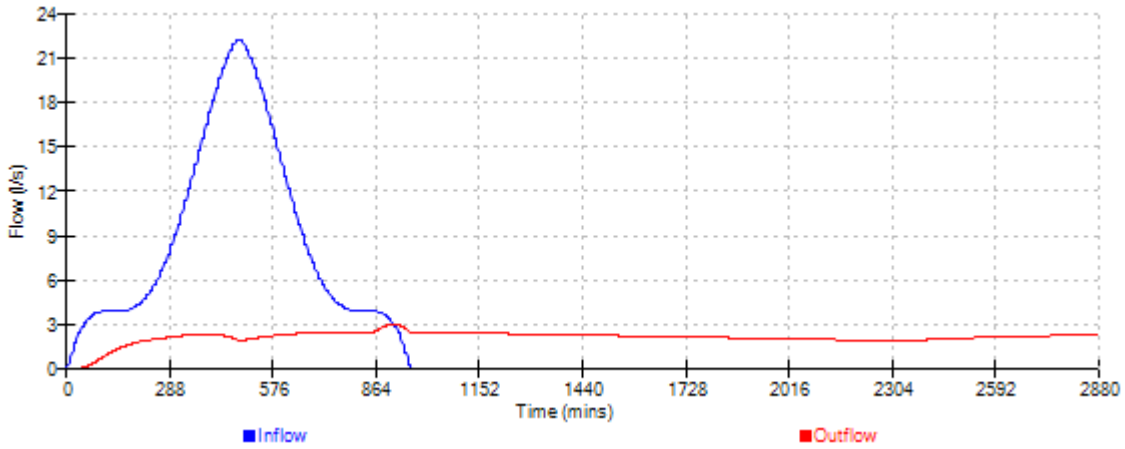
Unit Reference	MD-SHE-0072-2500-1200-2500
Design Head (m)	1.200
Design Flow (l/s)	2.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	72
Invert Level (m)	55.600
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

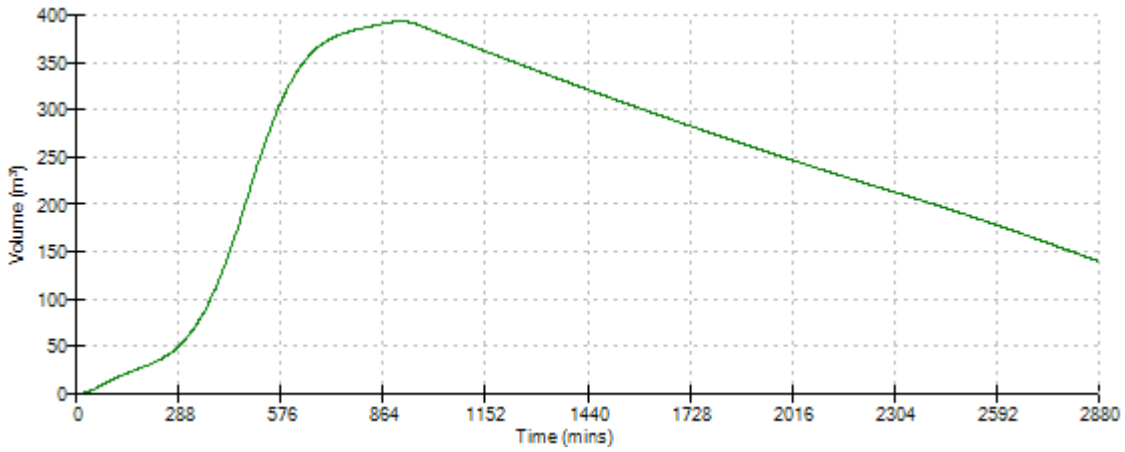
Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	2.5
Flush-Flo™	0.318	2.3
Kick-Flo®	0.644	1.9
Mean Flow over Head Range	-	2.1

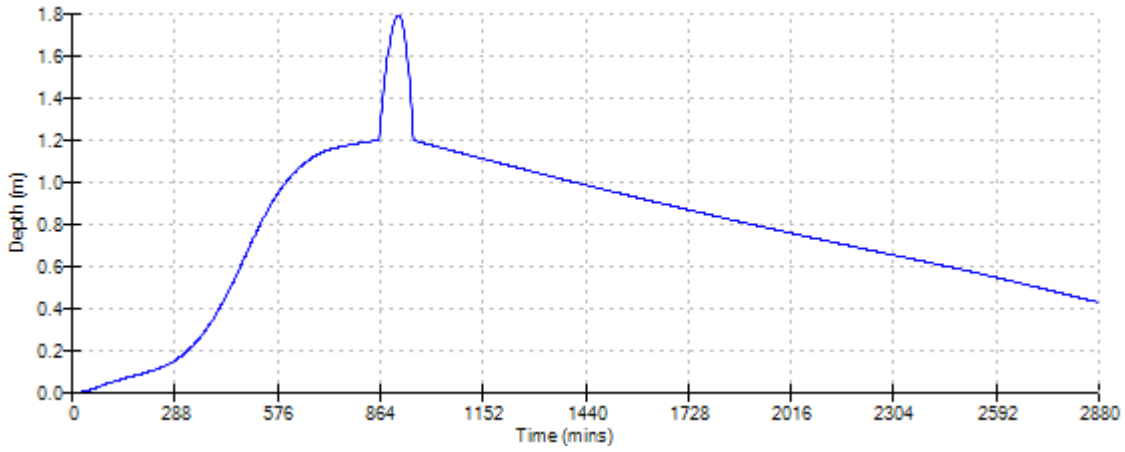
The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake Optimum® as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.9	1.200	2.5	3.000	3.8	7.000	5.7
0.200	2.2	1.400	2.7	3.500	4.1	7.500	5.9
0.300	2.3	1.600	2.8	4.000	4.4	8.000	6.0
0.400	2.3	1.800	3.0	4.500	4.6	8.500	6.2
0.500	2.2	2.000	3.2	5.000	4.8	9.000	6.4
0.600	2.0	2.200	3.3	5.500	5.1	9.500	6.5
0.800	2.1	2.400	3.4	6.000	5.3		
1.000	2.3	2.600	3.6	6.500	5.5		

Cascade Event: 960 min Winter for TANK 1.srcx







Cascade Summary of Results for TANK 2.srcx

Upstream Structures	Outflow To	Overflow To
(None)	SWALE 1.srcx	(None)

Half Drain Time : 776 minutes.

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
15 min Summer	51.937	0.437	0.0	2.5	2.5	84.5	O K
30 min Summer	52.081	0.581	0.0	2.5	2.5	112.4	O K
60 min Summer	52.230	0.730	0.0	2.5	2.5	141.1	O K
120 min Summer	52.371	0.871	0.0	2.5	2.5	168.2	O K
180 min Summer	52.438	0.938	0.0	2.5	2.5	181.2	O K
240 min Summer	52.473	0.973	0.0	2.5	2.5	188.0	O K
360 min Summer	52.510	1.010	0.0	2.5	2.5	195.2	O K
480 min Summer	52.519	1.019	0.0	2.5	2.5	196.8	O K
600 min Summer	52.511	1.011	0.0	2.5	2.5	195.4	O K
720 min Summer	52.499	0.999	0.0	2.5	2.5	193.0	O K
960 min Summer	52.472	0.972	0.0	2.5	2.5	187.8	O K
1440 min Summer	52.415	0.915	0.0	2.5	2.5	176.8	O K
2160 min Summer	52.330	0.830	0.0	2.5	2.5	160.3	O K
2880 min Summer	52.246	0.746	0.0	2.5	2.5	144.2	O K
4320 min Summer	52.090	0.590	0.0	2.5	2.5	114.1	O K
5760 min Summer	51.954	0.454	0.0	2.5	2.5	87.7	O K
7200 min Summer	51.841	0.341	0.0	2.5	2.5	66.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	131.851	0.0	86.4	19
30 min Summer	88.566	0.0	116.1	34
60 min Summer	56.713	0.0	148.8	64
120 min Summer	35.004	0.0	183.7	122
180 min Summer	25.973	0.0	204.4	182
240 min Summer	20.877	0.0	219.1	242
360 min Summer	15.365	0.0	241.9	362
480 min Summer	12.341	0.0	259.1	480
600 min Summer	10.402	0.0	273.0	594
720 min Summer	9.042	0.0	284.7	640
960 min Summer	7.241	0.0	304.0	760
1440 min Summer	5.284	0.0	332.6	1012
2160 min Summer	3.848	0.0	363.5	1424
2880 min Summer	3.068	0.0	386.5	1820
4320 min Summer	2.226	0.0	420.6	2596
5760 min Summer	1.771	0.0	446.1	3352
7200 min Summer	1.483	0.0	467.2	4040

Cascade Summary of Results for TANK 2.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
8640 min Summer	51.753	0.253	0.0	2.5	2.5	48.8	O K
10080 min Summer	51.685	0.185	0.0	2.5	2.5	35.7	O K
15 min Winter	51.991	0.491	0.0	2.5	2.5	94.8	O K
30 min Winter	52.154	0.654	0.0	2.5	2.5	126.3	O K
60 min Winter	52.323	0.823	0.0	2.5	2.5	159.0	O K
120 min Winter	52.485	0.985	0.0	2.5	2.5	190.3	O K
180 min Winter	52.565	1.065	0.0	2.5	2.5	205.8	O K
240 min Winter	52.610	1.110	0.0	2.5	2.5	214.5	O K
360 min Winter	52.662	1.162	0.0	2.5	2.5	224.5	O K
480 min Winter	52.682	1.182	0.0	2.5	2.5	228.3	O K
600 min Winter	52.684	1.184	0.0	2.5	2.5	228.8	O K
720 min Winter	52.675	1.175	0.0	2.5	2.5	227.0	O K
960 min Winter	52.638	1.138	0.0	2.5	2.5	220.0	O K
1440 min Winter	52.562	1.062	0.0	2.5	2.5	205.1	O K
2160 min Winter	52.436	0.936	0.0	2.5	2.5	180.8	O K
2880 min Winter	52.307	0.807	0.0	2.5	2.5	156.0	O K
4320 min Winter	52.068	0.568	0.0	2.5	2.5	109.7	O K
5760 min Winter	51.866	0.366	0.0	2.5	2.5	70.6	O K
7200 min Winter	51.712	0.212	0.0	2.5	2.5	40.9	O K
8640 min Winter	51.616	0.116	0.0	2.5	2.5	22.4	O K
10080 min Winter	51.593	0.093	0.0	2.3	2.3	18.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.284	0.0	485.5	4752
10080 min Summer	1.137	0.0	501.3	5352
15 min Winter	131.851	0.0	96.8	19
30 min Winter	88.566	0.0	130.1	33
60 min Winter	56.713	0.0	166.6	62
120 min Winter	35.004	0.0	205.7	120
180 min Winter	25.973	0.0	229.0	180
240 min Winter	20.877	0.0	245.5	238
360 min Winter	15.365	0.0	271.0	354
480 min Winter	12.341	0.0	290.3	468
600 min Winter	10.402	0.0	305.7	578
720 min Winter	9.042	0.0	318.9	686
960 min Winter	7.241	0.0	340.4	884
1440 min Winter	5.284	0.0	371.1	1098
2160 min Winter	3.848	0.0	407.1	1556
2880 min Winter	3.068	0.0	432.9	1988
4320 min Winter	2.226	0.0	471.1	2808
5760 min Winter	1.771	0.0	499.7	3520
7200 min Winter	1.483	0.0	523.3	4176
8640 min Winter	1.284	0.0	543.6	4664
10080 min Winter	1.137	0.0	561.5	5144

Cascade Rainfall Details for TANK 2.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)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.350

Time (mins) From:	To:	Area (ha)
0	4	0.350

Cascade Model Details for TANK 2.srcx

Storage is Online Cover Level (m) 53.410

Cellular Storage Structure

Invert Level (m) 51.500 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

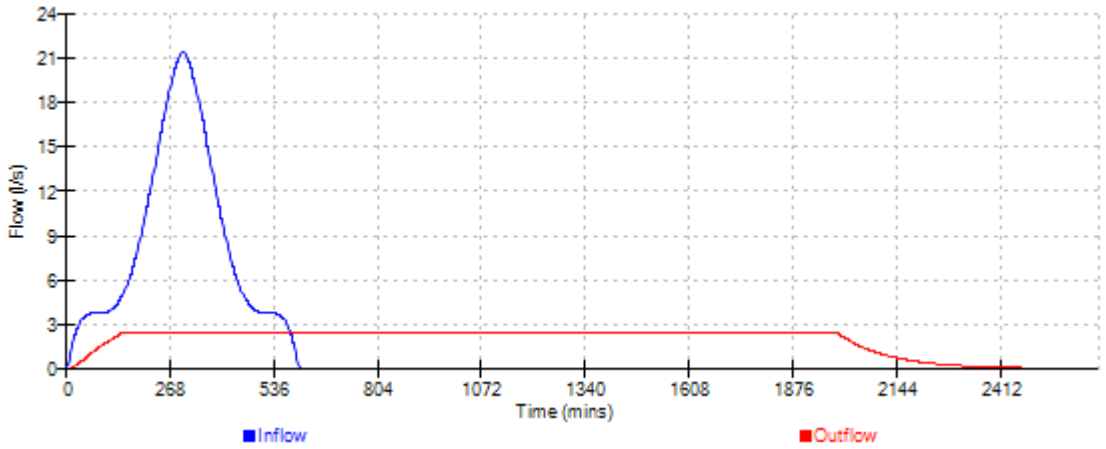
Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	203.4	0.0	1.201	3.4	0.0
1.200	203.4	0.0			

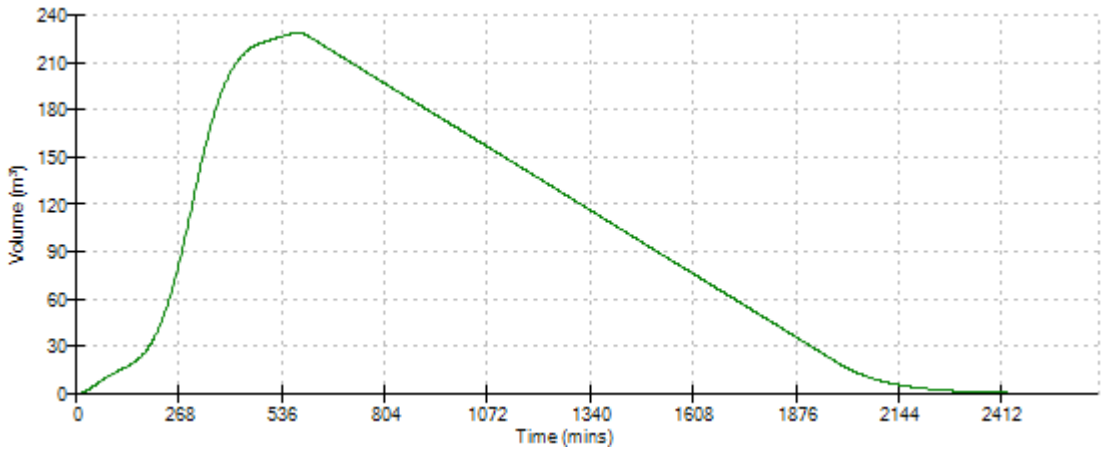
Pump Outflow Control

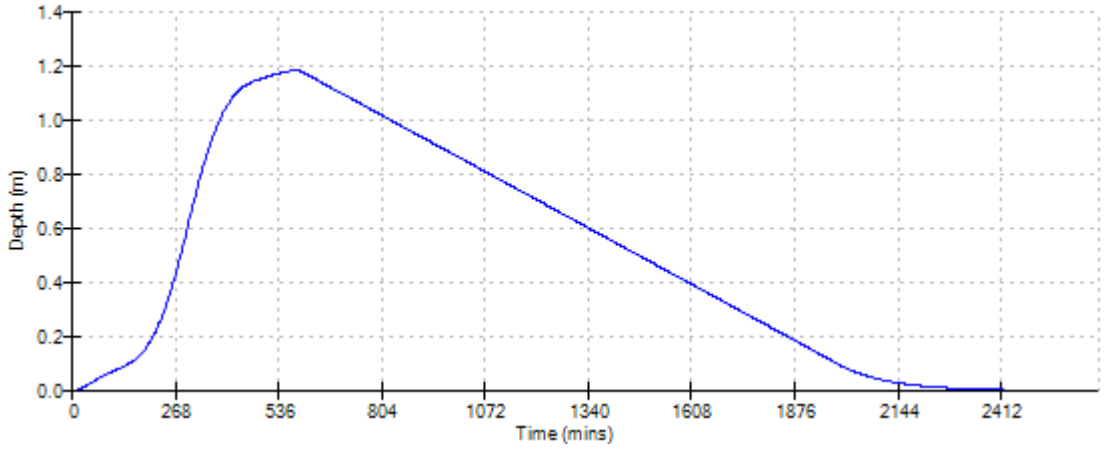
Invert Level (m) 51.500

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.5000	0.900	2.5000	1.700	2.5000	2.500	2.5000
0.200	2.5000	1.000	2.5000	1.800	2.5000	2.600	2.5000
0.300	2.5000	1.100	2.5000	1.900	2.5000	2.700	2.5000
0.400	2.5000	1.200	2.5000	2.000	2.5000	2.800	2.5000
0.500	2.5000	1.300	2.5000	2.100	2.5000	2.900	2.5000
0.600	2.5000	1.400	2.5000	2.200	2.5000	3.000	2.5000
0.700	2.5000	1.500	2.5000	2.300	2.5000		
0.800	2.5000	1.600	2.5000	2.400	2.5000		

Cascade Event: 600 min Winter for TANK 2.srcx







Cascade Summary of Results for TANK 3.srcx

Upstream Structures	Outflow To	Overflow To
PP1.srcx POND.srcx	(None)	

Half Drain Time : 115 minutes.

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
15 min Summer	54.380	0.380	0.0	5.0	5.0	33.3	O K
30 min Summer	54.502	0.502	0.0	5.0	5.0	44.0	O K
60 min Summer	54.623	0.623	0.0	5.0	5.0	54.6	O K
120 min Summer	54.704	0.704	0.0	5.0	5.0	61.7	O K
180 min Summer	54.713	0.713	0.0	5.0	5.0	62.5	O K
240 min Summer	54.702	0.702	0.0	5.0	5.0	61.5	O K
360 min Summer	54.679	0.679	0.0	5.0	5.0	59.4	O K
480 min Summer	54.660	0.660	0.0	5.0	5.0	57.8	O K
600 min Summer	54.630	0.630	0.0	5.0	5.0	55.2	O K
720 min Summer	54.583	0.583	0.0	5.0	5.0	51.1	O K
960 min Summer	54.471	0.471	0.0	5.0	5.0	41.3	O K
1440 min Summer	54.302	0.302	0.0	5.0	5.0	26.4	O K
2160 min Summer	54.167	0.167	0.0	4.9	4.9	14.6	O K
2880 min Summer	54.120	0.120	0.0	4.5	4.5	10.5	O K
4320 min Summer	54.091	0.091	0.0	3.3	3.3	8.0	O K
5760 min Summer	54.078	0.078	0.0	2.7	2.7	6.8	O K
7200 min Summer	54.070	0.070	0.0	2.3	2.3	6.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	131.851	0.0	44.4	18
30 min Summer	88.566	0.0	60.2	33
60 min Summer	56.713	0.0	77.6	62
120 min Summer	35.004	0.0	96.1	122
180 min Summer	25.973	0.0	107.1	176
240 min Summer	20.877	0.0	114.9	204
360 min Summer	15.365	0.0	126.9	280
480 min Summer	12.341	0.0	136.0	344
600 min Summer	10.402	0.0	143.3	394
720 min Summer	9.042	0.0	149.5	454
960 min Summer	7.241	0.0	159.6	578
1440 min Summer	5.284	0.0	174.5	808
2160 min Summer	3.848	0.0	190.5	1140
2880 min Summer	3.068	0.0	202.3	1472
4320 min Summer	2.226	0.0	219.6	2204
5760 min Summer	1.771	0.0	232.3	2936
7200 min Summer	1.483	0.0	242.7	3672

Cascade Summary of Results for TANK 3.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
8640 min Summer	54.064	0.064	0.0	1.9	1.9	5.6	O K
10080 min Summer	54.059	0.059	0.0	1.7	1.7	5.2	O K
15 min Winter	54.428	0.428	0.0	5.0	5.0	37.5	O K
30 min Winter	54.569	0.569	0.0	5.0	5.0	49.8	O K
60 min Winter	54.702	0.702	0.0	5.0	5.0	61.5	O K
120 min Winter	54.828	0.828	0.0	5.1	5.1	70.2	O K
180 min Winter	55.155	1.155	0.0	5.9	5.9	70.8	O K
240 min Winter	54.894	0.894	0.0	5.3	5.3	70.3	O K
360 min Winter	54.774	0.774	0.0	5.0	5.0	67.8	O K
480 min Winter	54.746	0.746	0.0	5.0	5.0	65.4	O K
600 min Winter	54.674	0.674	0.0	5.0	5.0	59.0	O K
720 min Winter	54.598	0.598	0.0	5.0	5.0	52.3	O K
960 min Winter	54.419	0.419	0.0	5.0	5.0	36.7	O K
1440 min Winter	54.198	0.198	0.0	5.0	5.0	17.4	O K
2160 min Winter	54.111	0.111	0.0	4.2	4.2	9.7	O K
2880 min Winter	54.091	0.091	0.0	3.3	3.3	8.0	O K
4320 min Winter	54.073	0.073	0.0	2.4	2.4	6.4	O K
5760 min Winter	54.064	0.064	0.0	1.9	1.9	5.6	O K
7200 min Winter	54.057	0.057	0.0	1.6	1.6	5.0	O K
8640 min Winter	54.053	0.053	0.0	1.4	1.4	4.6	O K
10080 min Winter	54.049	0.049	0.0	1.2	1.2	4.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.284	0.0	251.5	4376
10080 min Summer	1.137	0.0	259.1	5080
15 min Winter	131.851	0.0	49.9	18
30 min Winter	88.566	0.0	67.6	33
60 min Winter	56.713	0.0	87.1	62
120 min Winter	35.004	0.0	107.8	118
180 min Winter	25.973	0.0	120.2	168
240 min Winter	20.877	0.0	128.9	212
360 min Winter	15.365	0.0	142.4	284
480 min Winter	12.341	0.0	152.5	350
600 min Winter	10.402	0.0	160.7	414
720 min Winter	9.042	0.0	167.6	490
960 min Winter	7.241	0.0	179.0	608
1440 min Winter	5.284	0.0	195.8	812
2160 min Winter	3.848	0.0	213.7	1108
2880 min Winter	3.068	0.0	227.0	1468
4320 min Winter	2.226	0.0	246.4	2184
5760 min Winter	1.771	0.0	260.8	2928
7200 min Winter	1.483	0.0	272.6	3608
8640 min Winter	1.284	0.0	282.5	4320
10080 min Winter	1.137	0.0	291.2	5016

Cascade Rainfall Details for TANK 3.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)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.142

Time (mins) From:	To:	Area (ha)
0	4	0.142

Cascade Model Details for TANK 3.srcx

Storage is Online Cover Level (m) 55.500

Cellular Storage Structure

Invert Level (m) 54.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	92.2	0.0	0.801	2.2	0.0
0.800	92.2	0.0			

Hydro-Brake Optimum® Outflow Control

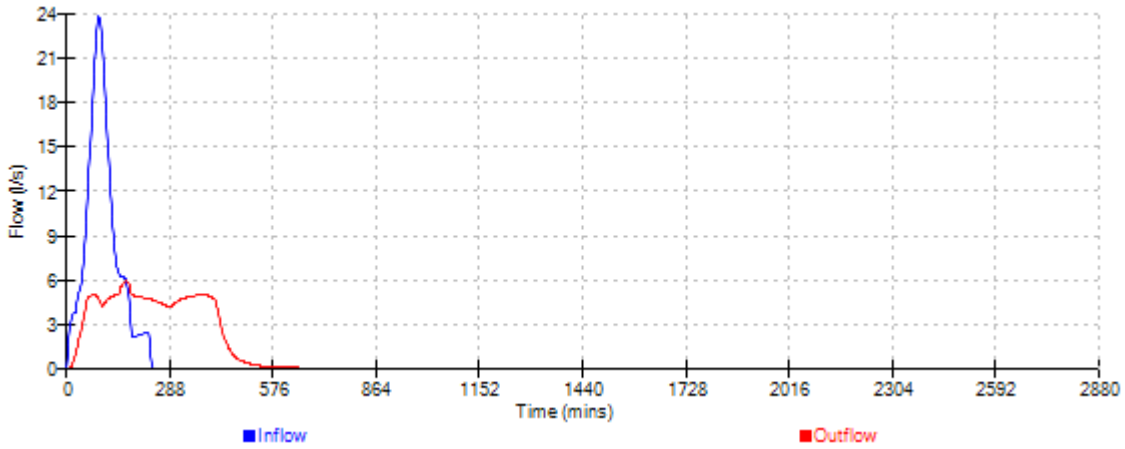
Unit Reference	MD-SHE-0109-5000-0800-5000
Design Head (m)	0.800
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	109
Invert Level (m)	54.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

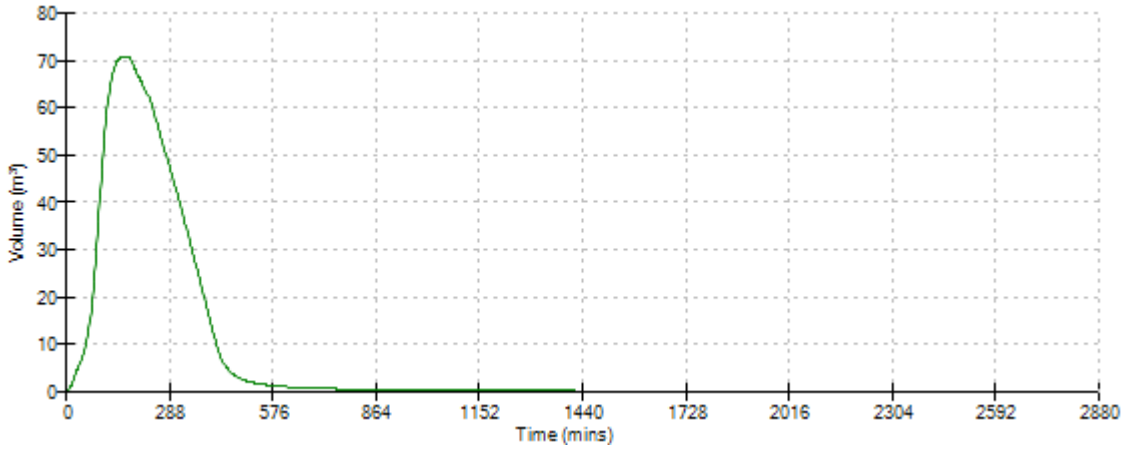
Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	5.0
Flush-Flo™	0.242	5.0
Kick-Flo®	0.537	4.2
Mean Flow over Head Range	-	4.3

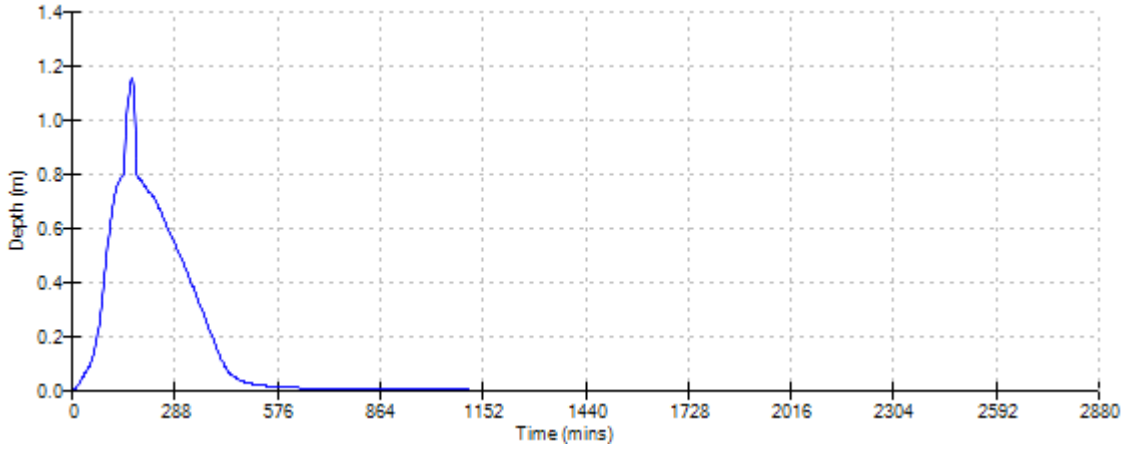
The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake Optimum® as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.7	1.200	6.0	3.000	9.3	7.000	13.9
0.200	5.0	1.400	6.5	3.500	10.0	7.500	14.4
0.300	5.0	1.600	6.9	4.000	10.6	8.000	14.8
0.400	4.8	1.800	7.3	4.500	11.3	8.500	15.2
0.500	4.5	2.000	7.7	5.000	11.8	9.000	15.7
0.600	4.4	2.200	8.0	5.500	12.4	9.500	16.1
0.800	5.0	2.400	8.4	6.000	12.9		
1.000	5.5	2.600	8.7	6.500	13.4		

Cascade Event: 180 min Winter for TANK 3.srcx







Cascade Summary of Results for TANK 4.srcx

Upstream Structures	Outflow To	Overflow To
(None)	SWALE 2.srcx	(None)

Half Drain Time : 100 minutes.

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
15 min Summer	53.561	0.461	0.0	2.5	2.5	18.5	O K
30 min Summer	53.697	0.597	0.0	2.5	2.5	23.9	O K
60 min Summer	53.800	0.700	0.0	2.5	2.5	28.1	O K
120 min Summer	53.837	0.737	0.0	2.5	2.5	29.5	O K
180 min Summer	53.825	0.725	0.0	2.5	2.5	29.1	O K
240 min Summer	53.802	0.702	0.0	2.5	2.5	28.1	O K
360 min Summer	53.752	0.652	0.0	2.5	2.5	26.1	O K
480 min Summer	53.700	0.600	0.0	2.5	2.5	24.1	O K
600 min Summer	53.646	0.546	0.0	2.5	2.5	21.9	O K
720 min Summer	53.582	0.482	0.0	2.5	2.5	19.3	O K
960 min Summer	53.470	0.370	0.0	2.5	2.5	14.8	O K
1440 min Summer	53.321	0.221	0.0	2.5	2.5	8.9	O K
2160 min Summer	53.220	0.120	0.0	2.3	2.3	4.8	O K
2880 min Summer	53.189	0.089	0.0	2.0	2.0	3.6	O K
4320 min Summer	53.167	0.067	0.0	1.5	1.5	2.7	O K
5760 min Summer	53.157	0.057	0.0	1.2	1.2	2.3	O K
7200 min Summer	53.151	0.051	0.0	1.0	1.0	2.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	131.851	0.0	20.2	18
30 min Summer	88.566	0.0	27.2	32
60 min Summer	56.713	0.0	34.9	62
120 min Summer	35.004	0.0	43.0	104
180 min Summer	25.973	0.0	47.9	136
240 min Summer	20.877	0.0	51.3	170
360 min Summer	15.365	0.0	56.7	240
480 min Summer	12.341	0.0	60.7	310
600 min Summer	10.402	0.0	64.0	380
720 min Summer	9.042	0.0	66.7	442
960 min Summer	7.241	0.0	71.2	560
1440 min Summer	5.284	0.0	78.0	782
2160 min Summer	3.848	0.0	85.2	1124
2880 min Summer	3.068	0.0	90.6	1468
4320 min Summer	2.226	0.0	98.5	2200
5760 min Summer	1.771	0.0	104.5	2896
7200 min Summer	1.483	0.0	109.5	3672

Cascade Summary of Results for TANK 4.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
8640 min Summer	53.146	0.046	0.0	0.9	0.9	1.8	O K
10080 min Summer	53.143	0.043	0.0	0.8	0.8	1.7	O K
15 min Winter	53.622	0.522	0.0	2.5	2.5	20.9	O K
30 min Winter	53.776	0.676	0.0	2.5	2.5	27.1	O K
60 min Winter	53.900	0.800	0.0	2.5	2.5	32.1	O K
120 min Winter	54.501	1.401	0.0	3.2	3.2	33.3	Flood Risk
180 min Winter	54.352	1.252	0.0	3.1	3.1	33.0	Flood Risk
240 min Winter	53.919	0.819	0.0	2.5	2.5	32.1	O K
360 min Winter	53.828	0.728	0.0	2.5	2.5	29.2	O K
480 min Winter	53.748	0.648	0.0	2.5	2.5	26.0	O K
600 min Winter	53.665	0.565	0.0	2.5	2.5	22.6	O K
720 min Winter	53.561	0.461	0.0	2.5	2.5	18.5	O K
960 min Winter	53.398	0.298	0.0	2.5	2.5	12.0	O K
1440 min Winter	53.233	0.133	0.0	2.3	2.3	5.3	O K
2160 min Winter	53.182	0.082	0.0	1.8	1.8	3.3	O K
2880 min Winter	53.167	0.067	0.0	1.5	1.5	2.7	O K
4320 min Winter	53.153	0.053	0.0	1.1	1.1	2.1	O K
5760 min Winter	53.146	0.046	0.0	0.9	0.9	1.8	O K
7200 min Winter	53.142	0.042	0.0	0.7	0.7	1.7	O K
8640 min Winter	53.138	0.038	0.0	0.6	0.6	1.5	O K
10080 min Winter	53.136	0.036	0.0	0.6	0.6	1.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.284	0.0	113.7	4296
10080 min Summer	1.137	0.0	117.4	5016
15 min Winter	131.851	0.0	22.7	18
30 min Winter	88.566	0.0	30.5	32
60 min Winter	56.713	0.0	39.0	60
120 min Winter	35.004	0.0	48.2	98
180 min Winter	25.973	0.0	53.7	138
240 min Winter	20.877	0.0	57.5	182
360 min Winter	15.365	0.0	63.5	260
480 min Winter	12.341	0.0	68.0	336
600 min Winter	10.402	0.0	71.6	410
720 min Winter	9.042	0.0	74.7	474
960 min Winter	7.241	0.0	79.8	584
1440 min Winter	5.284	0.0	87.3	782
2160 min Winter	3.848	0.0	95.4	1104
2880 min Winter	3.068	0.0	101.4	1468
4320 min Winter	2.226	0.0	110.4	2184
5760 min Winter	1.771	0.0	117.1	2936
7200 min Winter	1.483	0.0	122.6	3632
8640 min Winter	1.284	0.0	127.4	4296
10080 min Winter	1.137	0.0	131.5	5120

Cascade Rainfall Details for TANK 4.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)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.082

Time (mins) From:	To:	Area (ha)
0	4	0.082

Cascade Model Details for TANK 4.srcx

Storage is Online Cover Level (m) 54.600

Cellular Storage Structure

Invert Level (m) 53.100 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	42.2	0.0	0.801	2.2	0.0
0.800	42.2	0.0			

Hydro-Brake Optimum® Outflow Control

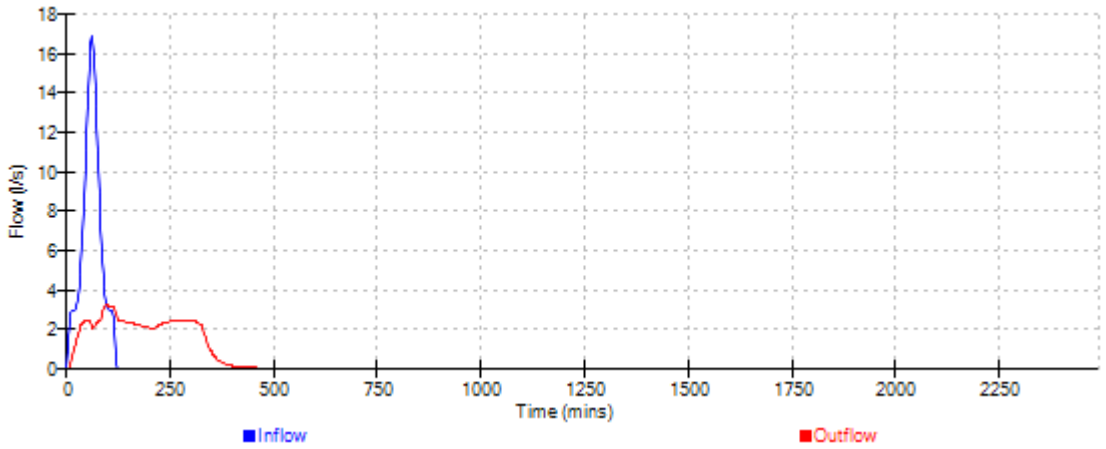
Unit Reference	MD-SHE-0078-2500-0800-2500
Design Head (m)	0.800
Design Flow (l/s)	2.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	78
Invert Level (m)	53.100
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

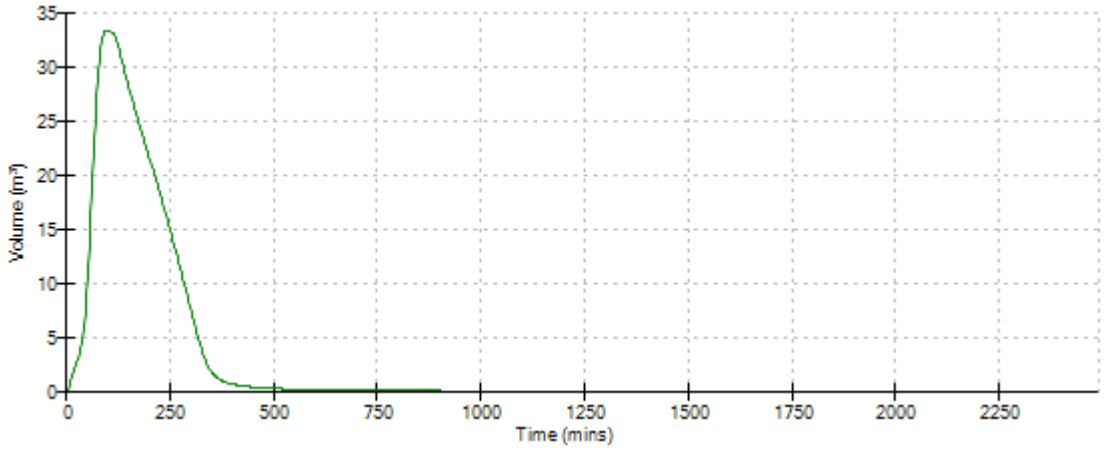
Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	2.5
Flush-Flo™	0.236	2.5
Kick-Flo®	0.508	2.0
Mean Flow over Head Range	-	2.2

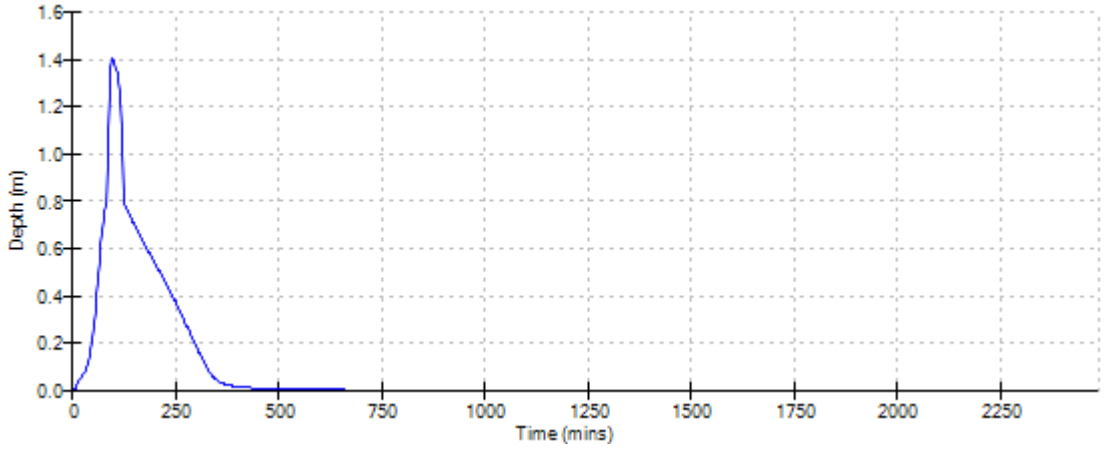
The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake Optimum® as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.2	1.200	3.0	3.000	4.6	7.000	6.8
0.200	2.5	1.400	3.2	3.500	4.9	7.500	7.0
0.300	2.5	1.600	3.4	4.000	5.2	8.000	7.3
0.400	2.4	1.800	3.6	4.500	5.5	8.500	7.5
0.500	2.1	2.000	3.8	5.000	5.8	9.000	7.7
0.600	2.2	2.200	4.0	5.500	6.1	9.500	7.9
0.800	2.5	2.400	4.1	6.000	6.3		
1.000	2.8	2.600	4.3	6.500	6.6		

Cascade Event: 120 min Winter for TANK 4.srcx







Cascade Summary of Results for TANK 5.srcx

Upstream Structures	Outflow To	Overflow To
(None)	SWALE 2.srcx	(None)

Half Drain Time : 208 minutes.

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
15 min Summer	51.142	0.392	0.0	2.5	2.5	31.1	O K
30 min Summer	51.266	0.516	0.0	2.5	2.5	40.9	O K
60 min Summer	51.381	0.631	0.0	2.5	2.5	50.0	O K
120 min Summer	51.460	0.710	0.0	2.5	2.5	56.3	O K
180 min Summer	51.473	0.723	0.0	2.5	2.5	57.3	O K
240 min Summer	51.465	0.715	0.0	2.5	2.5	56.7	O K
360 min Summer	51.446	0.696	0.0	2.5	2.5	55.1	O K
480 min Summer	51.421	0.671	0.0	2.5	2.5	53.2	O K
600 min Summer	51.394	0.644	0.0	2.5	2.5	51.0	O K
720 min Summer	51.366	0.616	0.0	2.5	2.5	48.8	O K
960 min Summer	51.310	0.560	0.0	2.5	2.5	44.4	O K
1440 min Summer	51.181	0.431	0.0	2.5	2.5	34.1	O K
2160 min Summer	51.034	0.284	0.0	2.5	2.5	22.5	O K
2880 min Summer	50.941	0.191	0.0	2.5	2.5	15.2	O K
4320 min Summer	50.856	0.106	0.0	2.2	2.2	8.4	O K
5760 min Summer	50.834	0.084	0.0	1.9	1.9	6.6	O K
7200 min Summer	50.821	0.071	0.0	1.6	1.6	5.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	131.851	0.0	32.7	18
30 min Summer	88.566	0.0	44.0	33
60 min Summer	56.713	0.0	56.5	62
120 min Summer	35.004	0.0	69.8	122
180 min Summer	25.973	0.0	77.6	178
240 min Summer	20.877	0.0	83.2	206
360 min Summer	15.365	0.0	91.9	268
480 min Summer	12.341	0.0	98.4	336
600 min Summer	10.402	0.0	103.7	406
720 min Summer	9.042	0.0	108.1	476
960 min Summer	7.241	0.0	115.5	616
1440 min Summer	5.284	0.0	126.4	866
2160 min Summer	3.848	0.0	138.1	1216
2880 min Summer	3.068	0.0	146.8	1556
4320 min Summer	2.226	0.0	159.7	2208
5760 min Summer	1.771	0.0	169.5	2936
7200 min Summer	1.483	0.0	177.5	3672

Cascade Summary of Results for TANK 5.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
8640 min Summer	50.813	0.063	0.0	1.4	1.4	5.0	O K
10080 min Summer	50.808	0.058	0.0	1.2	1.2	4.6	O K
15 min Winter	51.192	0.442	0.0	2.5	2.5	35.0	O K
30 min Winter	51.333	0.583	0.0	2.5	2.5	46.2	O K
60 min Winter	51.464	0.714	0.0	2.5	2.5	56.6	O K
120 min Winter	51.791	1.041	0.0	2.8	2.8	64.2	O K
180 min Winter	52.077	1.327	0.0	3.1	3.1	65.1	Flood Risk
240 min Winter	51.895	1.145	0.0	2.9	2.9	64.5	O K
360 min Winter	51.549	0.799	0.0	2.5	2.5	63.3	O K
480 min Winter	51.515	0.765	0.0	2.5	2.5	60.6	O K
600 min Winter	51.476	0.726	0.0	2.5	2.5	57.5	O K
720 min Winter	51.434	0.684	0.0	2.5	2.5	54.2	O K
960 min Winter	51.349	0.599	0.0	2.5	2.5	47.5	O K
1440 min Winter	51.148	0.398	0.0	2.5	2.5	31.5	O K
2160 min Winter	50.951	0.201	0.0	2.5	2.5	15.9	O K
2880 min Winter	50.864	0.114	0.0	2.3	2.3	9.0	O K
4320 min Winter	50.827	0.077	0.0	1.7	1.7	6.1	O K
5760 min Winter	50.813	0.063	0.0	1.4	1.4	5.0	O K
7200 min Winter	50.806	0.056	0.0	1.2	1.2	4.4	O K
8640 min Winter	50.801	0.051	0.0	1.0	1.0	4.0	O K
10080 min Winter	50.797	0.047	0.0	0.9	0.9	3.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.284	0.0	184.4	4400
10080 min Summer	1.137	0.0	190.4	5136
15 min Winter	131.851	0.0	36.7	18
30 min Winter	88.566	0.0	49.3	32
60 min Winter	56.713	0.0	63.3	62
120 min Winter	35.004	0.0	78.1	118
180 min Winter	25.973	0.0	87.0	170
240 min Winter	20.877	0.0	93.2	200
360 min Winter	15.365	0.0	102.9	282
480 min Winter	12.341	0.0	110.2	362
600 min Winter	10.402	0.0	116.1	440
720 min Winter	9.042	0.0	121.1	514
960 min Winter	7.241	0.0	129.3	666
1440 min Winter	5.284	0.0	141.5	924
2160 min Winter	3.848	0.0	154.7	1252
2880 min Winter	3.068	0.0	164.5	1532
4320 min Winter	2.226	0.0	178.9	2204
5760 min Winter	1.771	0.0	189.8	2936
7200 min Winter	1.483	0.0	198.8	3640
8640 min Winter	1.284	0.0	206.5	4368
10080 min Winter	1.137	0.0	213.3	5136

Cascade Rainfall Details for TANK 5.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)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.133

Time (mins) From:	To:	Area (ha)
0	4	0.133

Cascade Model Details for TANK 5.srcx

Storage is Online Cover Level (m) 52.250

Cellular Storage Structure

Invert Level (m) 50.750 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	83.4	0.0	0.801	3.4	0.0
0.800	83.4	0.0			

Hydro-Brake Optimum® Outflow Control

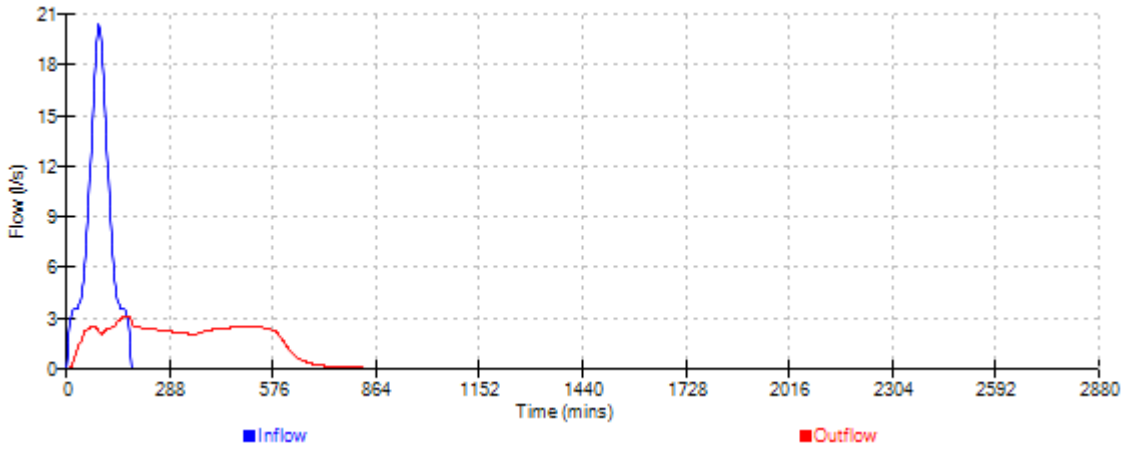
Unit Reference	MD-SHE-0078-2500-0800-2500
Design Head (m)	0.800
Design Flow (l/s)	2.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	78
Invert Level (m)	50.750
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

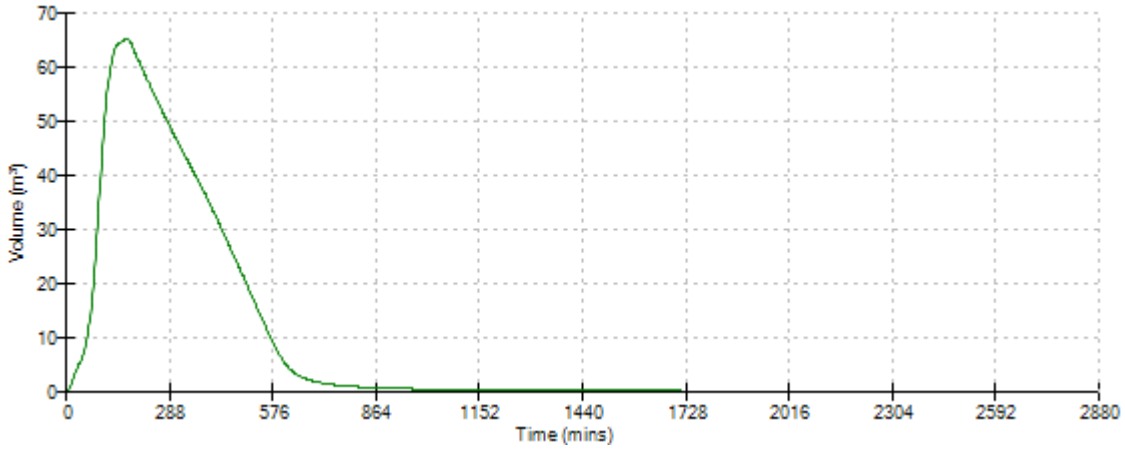
Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	2.5
Flush-Flo™	0.236	2.5
Kick-Flo®	0.508	2.0
Mean Flow over Head Range	-	2.2

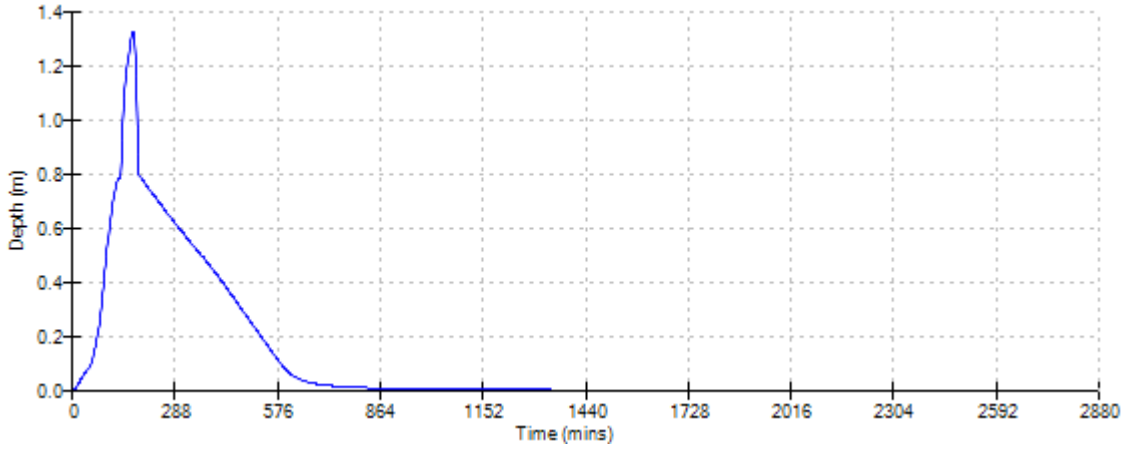
The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake Optimum® as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.2	1.200	3.0	3.000	4.6	7.000	6.8
0.200	2.5	1.400	3.2	3.500	4.9	7.500	7.0
0.300	2.5	1.600	3.4	4.000	5.2	8.000	7.3
0.400	2.4	1.800	3.6	4.500	5.5	8.500	7.5
0.500	2.1	2.000	3.8	5.000	5.8	9.000	7.7
0.600	2.2	2.200	4.0	5.500	6.1	9.500	7.9
0.800	2.5	2.400	4.1	6.000	6.3		
1.000	2.8	2.600	4.3	6.500	6.6		

Cascade Event: 180 min Winter for TANK 5.srcx







Cascade Summary of Results for TANK 6.srcx

Upstream Structures	Outflow To	Overflow To
(None)	POND.srcx	(None)

Half Drain Time : 352 minutes.

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
15 min Summer	52.040	0.340	0.0	2.5	2.5	42.7	O K
30 min Summer	52.150	0.450	0.0	2.5	2.5	56.5	O K
60 min Summer	52.259	0.559	0.0	2.5	2.5	70.2	O K
120 min Summer	52.349	0.649	0.0	2.5	2.5	81.5	O K
180 min Summer	52.379	0.679	0.0	2.5	2.5	85.3	O K
240 min Summer	52.385	0.685	0.0	2.5	2.5	86.1	O K
360 min Summer	52.379	0.679	0.0	2.5	2.5	85.2	O K
480 min Summer	52.366	0.666	0.0	2.5	2.5	83.6	O K
600 min Summer	52.350	0.650	0.0	2.5	2.5	81.6	O K
720 min Summer	52.333	0.633	0.0	2.5	2.5	79.5	O K
960 min Summer	52.297	0.597	0.0	2.5	2.5	75.0	O K
1440 min Summer	52.221	0.521	0.0	2.5	2.5	65.5	O K
2160 min Summer	52.097	0.397	0.0	2.5	2.5	49.9	O K
2880 min Summer	52.002	0.302	0.0	2.5	2.5	37.9	O K
4320 min Summer	51.879	0.179	0.0	2.4	2.4	22.4	O K
5760 min Summer	51.819	0.119	0.0	2.3	2.3	14.9	O K
7200 min Summer	51.794	0.094	0.0	2.1	2.1	11.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	131.851	0.0	44.1	18
30 min Summer	88.566	0.0	59.3	33
60 min Summer	56.713	0.0	76.3	62
120 min Summer	35.004	0.0	94.3	122
180 min Summer	25.973	0.0	105.0	182
240 min Summer	20.877	0.0	112.5	240
360 min Summer	15.365	0.0	124.2	310
480 min Summer	12.341	0.0	133.0	372
600 min Summer	10.402	0.0	140.1	436
720 min Summer	9.042	0.0	146.2	506
960 min Summer	7.241	0.0	156.1	646
1440 min Summer	5.284	0.0	170.8	924
2160 min Summer	3.848	0.0	186.9	1296
2880 min Summer	3.068	0.0	198.7	1644
4320 min Summer	2.226	0.0	216.0	2332
5760 min Summer	1.771	0.0	229.4	3000
7200 min Summer	1.483	0.0	240.2	3672

Cascade Summary of Results for TANK 6.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
8640 min Summer	51.782	0.082	0.0	1.8	1.8	10.3	O K
10080 min Summer	51.773	0.073	0.0	1.7	1.7	9.2	O K
15 min Winter	52.082	0.382	0.0	2.5	2.5	48.0	O K
30 min Winter	52.207	0.507	0.0	2.5	2.5	63.7	O K
60 min Winter	52.331	0.631	0.0	2.5	2.5	79.2	O K
120 min Winter	52.436	0.736	0.0	2.5	2.5	92.4	O K
180 min Winter	52.475	0.775	0.0	2.5	2.5	97.3	O K
240 min Winter	52.487	0.787	0.0	2.5	2.5	98.8	O K
360 min Winter	52.484	0.784	0.0	2.5	2.5	98.4	O K
480 min Winter	52.464	0.764	0.0	2.5	2.5	96.0	O K
600 min Winter	52.445	0.745	0.0	2.5	2.5	93.5	O K
720 min Winter	52.422	0.722	0.0	2.5	2.5	90.6	O K
960 min Winter	52.370	0.670	0.0	2.5	2.5	84.1	O K
1440 min Winter	52.258	0.558	0.0	2.5	2.5	70.0	O K
2160 min Winter	52.065	0.365	0.0	2.5	2.5	45.8	O K
2880 min Winter	51.932	0.232	0.0	2.5	2.5	29.2	O K
4320 min Winter	51.809	0.109	0.0	2.3	2.3	13.6	O K
5760 min Winter	51.782	0.082	0.0	1.9	1.9	10.3	O K
7200 min Winter	51.770	0.070	0.0	1.6	1.6	8.8	O K
8640 min Winter	51.762	0.062	0.0	1.4	1.4	7.8	O K
10080 min Winter	51.757	0.057	0.0	1.2	1.2	7.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.284	0.0	249.5	4408
10080 min Summer	1.137	0.0	257.6	5136
15 min Winter	131.851	0.0	49.4	18
30 min Winter	88.566	0.0	66.5	33
60 min Winter	56.713	0.0	85.5	62
120 min Winter	35.004	0.0	105.6	120
180 min Winter	25.973	0.0	117.6	176
240 min Winter	20.877	0.0	126.0	232
360 min Winter	15.365	0.0	139.1	340
480 min Winter	12.341	0.0	149.0	390
600 min Winter	10.402	0.0	157.0	464
720 min Winter	9.042	0.0	163.7	542
960 min Winter	7.241	0.0	174.8	696
1440 min Winter	5.284	0.0	191.3	1008
2160 min Winter	3.848	0.0	209.3	1368
2880 min Winter	3.068	0.0	222.5	1700
4320 min Winter	2.226	0.0	242.0	2292
5760 min Winter	1.771	0.0	256.9	2952
7200 min Winter	1.483	0.0	269.0	3680
8640 min Winter	1.284	0.0	279.5	4408
10080 min Winter	1.137	0.0	288.5	5144

Cascade Rainfall Details for TANK 6.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)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.180

Time (mins) From:	To:	Area (ha)
0	4	0.180

Cascade Model Details for TANK 6.srcx

Storage is Online Cover Level (m) 53.200

Cellular Storage Structure

Invert Level (m) 51.700 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	132.2	0.0	0.801	2.2	0.0
0.800	132.2	0.0			

Hydro-Brake Optimum® Outflow Control

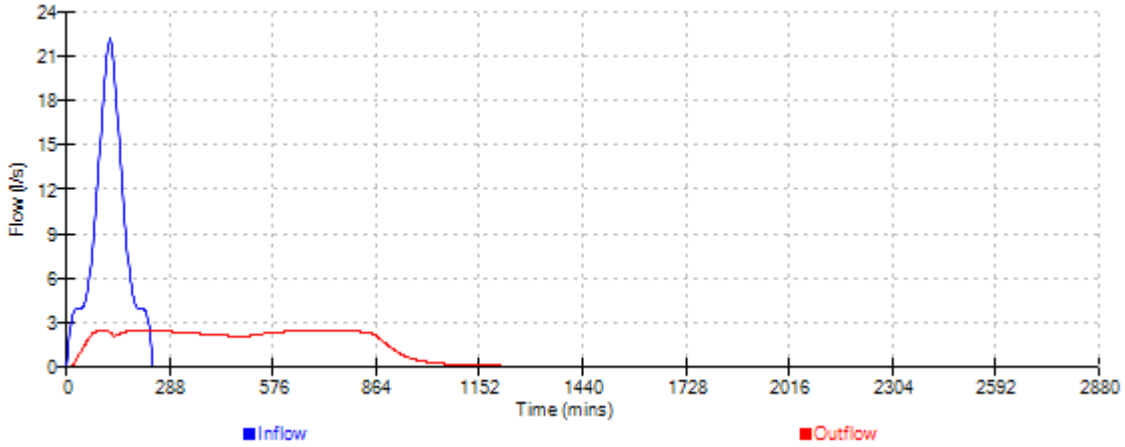
Unit Reference	MD-SHE-0078-2500-0800-2500
Design Head (m)	0.800
Design Flow (l/s)	2.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	78
Invert Level (m)	51.700
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

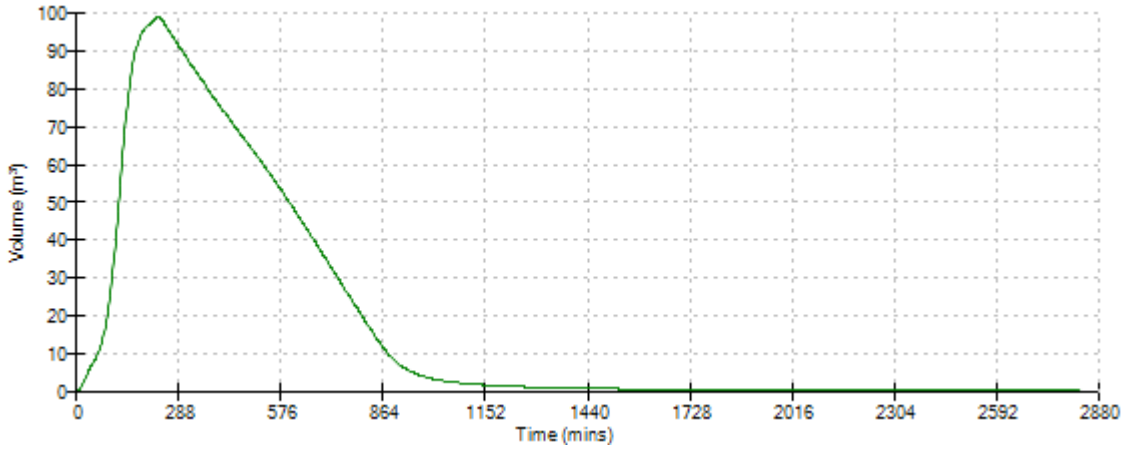
Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	2.5
Flush-Flo™	0.236	2.5
Kick-Flo®	0.508	2.0
Mean Flow over Head Range	-	2.2

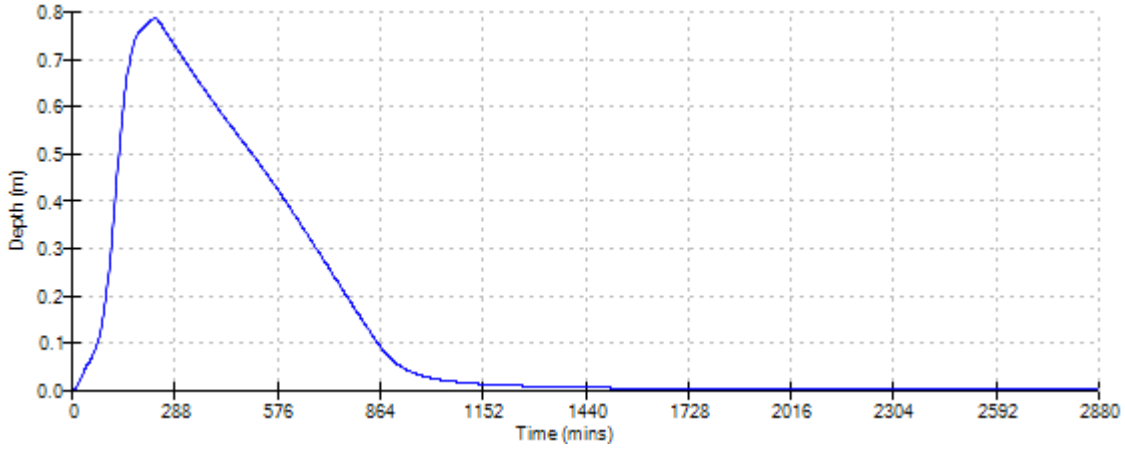
The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake Optimum® as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.2	1.200	3.0	3.000	4.6	7.000	6.8
0.200	2.5	1.400	3.2	3.500	4.9	7.500	7.0
0.300	2.5	1.600	3.4	4.000	5.2	8.000	7.3
0.400	2.4	1.800	3.6	4.500	5.5	8.500	7.5
0.500	2.1	2.000	3.8	5.000	5.8	9.000	7.7
0.600	2.2	2.200	4.0	5.500	6.1	9.500	7.9
0.800	2.5	2.400	4.1	6.000	6.3		
1.000	2.8	2.600	4.3	6.500	6.6		

Cascade Event: 240 min Winter for TANK 6.srcx







MicroDrainage Calculations – Pond

Cascade Summary of Results for POND.srcx

Upstream Structures	Outflow To	Overflow To
PP2.srcx	(None)	(None)
SWALE 1.srcx		
TANK 2.srcx		
SWALE 2.srcx		
TANK 4.srcx		
TANK 5.srcx		
TANK 1.srcx		
TANK 3.srcx		
PP1.srcx		
TANK 6.srcx		

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	49.315	0.315	15.0	261.1	O K
30 min Summer	49.415	0.415	15.0	352.0	O K
60 min Summer	49.516	0.516	15.0	447.8	O K
120 min Summer	49.629	0.629	15.0	558.9	O K
180 min Summer	49.694	0.694	15.0	625.9	O K
240 min Summer	49.738	0.738	15.0	671.8	O K
360 min Summer	49.801	0.801	15.0	739.0	O K
480 min Summer	49.843	0.843	15.0	784.5	O K
600 min Summer	49.873	0.873	15.0	817.7	O K
720 min Summer	49.894	0.894	15.0	841.2	O K
960 min Summer	49.908	0.908	15.0	856.4	O K
1440 min Summer	49.893	0.893	15.0	839.4	O K
2160 min Summer	49.854	0.854	15.0	796.2	O K
2880 min Summer	49.812	0.812	15.0	750.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	131.851	0.0	659.9	150
30 min Summer	88.566	0.0	884.0	207
60 min Summer	56.713	0.0	1146.9	276
120 min Summer	35.004	0.0	1416.4	348
180 min Summer	25.973	0.0	1575.7	398
240 min Summer	20.877	0.0	1687.2	440
360 min Summer	15.365	0.0	1855.4	518
480 min Summer	12.341	0.0	1972.0	590
600 min Summer	10.402	0.0	2059.4	654
720 min Summer	9.042	0.0	2131.2	728
960 min Summer	7.241	0.0	2245.7	962
1440 min Summer	5.284	0.0	2378.5	1316
2160 min Summer	3.848	0.0	2809.2	1648
2880 min Summer	3.068	0.0	2985.2	2016

Cascade Summary of Results for POND.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
4320 min Summer	49.716	0.716	15.0	648.7	O K
5760 min Summer	49.622	0.622	15.0	552.4	O K
7200 min Summer	49.541	0.541	15.0	472.1	O K
8640 min Summer	49.466	0.466	15.0	399.6	O K
10080 min Summer	49.387	0.387	15.0	326.3	O K
15 min Winter	49.350	0.350	15.0	292.3	O K
30 min Winter	49.458	0.458	15.0	392.2	O K
60 min Winter	49.573	0.573	15.0	502.9	O K
120 min Winter	49.701	0.701	15.0	632.7	O K
180 min Winter	49.776	0.776	15.0	711.7	O K
240 min Winter	49.825	0.825	15.0	764.4	O K
360 min Winter	49.895	0.895	15.0	841.9	O K
480 min Winter	49.943	0.943	15.0	896.3	O K
600 min Winter	49.978	0.978	15.0	936.3	O K
720 min Winter	50.005	1.005	15.0	967.4	O K
960 min Winter	50.033	1.033	15.0	1000.4	Flood Risk
1440 min Winter	50.034	1.034	15.0	1001.7	Flood Risk
2160 min Winter	49.982	0.982	15.0	941.1	O K
2880 min Winter	49.920	0.920	15.0	870.2	O K
4320 min Winter	49.764	0.764	15.0	698.8	O K
5760 min Winter	49.631	0.631	15.0	561.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
4320 min Summer	2.226	0.0	3226.7	2736
5760 min Summer	1.771	0.0	3444.4	3512
7200 min Summer	1.483	0.0	3605.5	4280
8640 min Summer	1.284	0.0	3744.1	5040
10080 min Summer	1.137	0.0	3862.8	5680
15 min Winter	131.851	0.0	739.1	168
30 min Winter	88.566	0.0	983.8	234
60 min Winter	56.713	0.0	1285.0	304
120 min Winter	35.004	0.0	1585.7	380
180 min Winter	25.973	0.0	1761.9	428
240 min Winter	20.877	0.0	1882.3	474
360 min Winter	15.365	0.0	2053.7	554
480 min Winter	12.341	0.0	2174.3	626
600 min Winter	10.402	0.0	2269.9	694
720 min Winter	9.042	0.0	2348.8	754
960 min Winter	7.241	0.0	2458.3	952
1440 min Winter	5.284	0.0	2416.0	1386
2160 min Winter	3.848	0.0	3146.9	1796
2880 min Winter	3.068	0.0	3342.7	2148
4320 min Winter	2.226	0.0	3577.6	2968
5760 min Winter	1.771	0.0	3860.5	3808

Cascade Summary of Results for POND.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
7200 min Winter	49.494	0.494	15.0	426.3	O K
8640 min Winter	49.346	0.346	15.0	289.2	O K
10080 min Winter	49.206	0.206	15.0	166.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
7200 min Winter	1.483	0.0	4040.6	4472
8640 min Winter	1.284	0.0	4195.1	5120
10080 min Winter	1.137	0.0	4329.9	5696

Cascade Rainfall Details for POND.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)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.546

Time (mins) From:	To:	Area (ha)
0	4	0.546

Cascade Model Details for POND.srcx

Storage is Online Cover Level (m) 50.320

Tank or Pond Structure

Invert Level (m) 49.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	771.4	0.400	920.7	0.800	1079.0	1.200	1246.3
0.100	807.9	0.500	959.4	0.900	1120.0	1.300	1288.4
0.200	844.9	0.600	998.7	1.000	1161.5	1.400	1288.4
0.300	882.5	0.700	1038.6	1.100	1203.6		

Pump Outflow Control

Invert Level (m) 49.000

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	15.0000	0.900	15.0000	1.700	15.0000	2.500	15.0000
0.200	15.0000	1.000	15.0000	1.800	15.0000	2.600	15.0000
0.300	15.0000	1.100	15.0000	1.900	15.0000	2.700	15.0000
0.400	15.0000	1.200	15.0000	2.000	15.0000	2.800	15.0000
0.500	15.0000	1.300	15.0000	2.100	15.0000	2.900	15.0000
0.600	15.0000	1.400	15.0000	2.200	15.0000	3.000	15.0000
0.700	15.0000	1.500	15.0000	2.300	15.0000		
0.800	15.0000	1.600	15.0000	2.400	15.0000		

Cascade Event: 1440 min Winter for POND.srcx