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Structural Engineering
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Nickle Farm
Chartham
Canterbury
CT4 7PF

Proposed Polytunnels

Surface Water Design - Drainage Statement

Issue	A
Date	15 Oct 2021
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CONTENTS

APPENDICES

1.00 Introduction

1.01 Monson Engineering has been instructed to prepare a drainage statement in order to address planning conditions recommended by Kent Lead Local Flood Authority (LLFA) to Kent Local Planning Authority (LPA) with regards to the proposed polytunnels development at Nickle Farm, Chartham, Canterbury. These comments relate to planning application reference CA/21/01744.

1.02 The LLFA recommends the following conditions to be attached should the LPA be minded to grant planning permission:

i. Detailed sustainable surface water drainage scheme accommodating runoff generated for all rainfall intensities and durations up to and including the 1 in 100 year, allowing for climate change.

ii. Details of implementation, maintenance, and management of the scheme to be submitted, which shall include a timetable for its implementation and a management and maintenance plan for the scheme.

iii. Development shall not be brought to use until a verification report related to the scheme. The Report shall demonstrate that the drainage system constructed is consistent with that which was approved.

iv. Where infiltration is to be used, this will only be allowed within those parts of the site where information is submitted to demonstrate that there is no unacceptable risk to controlled waters and/or ground instability. Reason for this condition is to protect vulnerable groundwater resources and ensure compliance with the National Planning Policy Framework.

1.03 This drainage statement has not incorporated a verification report (1.02(iii)) as this will be produced once the development is constructed as per approved plans.

1.04 Kent County LLFA comments and recommendations as discussed above can be found in **Appendix A**.

1.05 Site location plan and development proposals can be found in **Appendix B**.

2.00 Drainage Proposals

Soakage Test

2.01 BRE365 soakage test was carried out at 4 locations for a previous planning application (Ref: CA/16/02331) within the Nickle Farm Estate. The average of the 4 infiltration rates obtained has been used for this design, 1.14×10^{-5} m/s (0.041 m/h).

Drainage

2.02 Due to the arc cross section of the polytunnel, any rainfall that lands on it will immediately runoff clockwise or anticlockwise, depending on whether it falls to the right (clockwise) or the left (anticlockwise) of the apex of the arc shape.

2.03 With the exception of the outer roofs of the two end polytunnels in any polytunnels group, rainfall that falls on the centre polytunnels as well as on the inner roofs of the end polytunnels will land on the ground beneath the covered area (*Figure 1*).

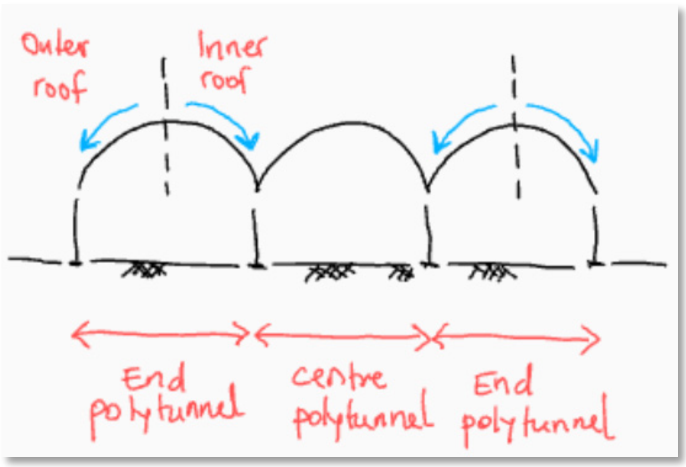


Figure 1: Polytunnels Configuration

2.04 Assuming 60% of this storm water infiltrates the ground, the remaining 40% runoff will follow the local topography of the covered ground. The design philosophy for the covered area is to contain this runoff within the covered area by constructing earth bunds using local soils. The resulting trenches will be filled with coarse aggregates.

2.05 Table 3 of Calculations attached in **Appendix C** show different heights “H” of earth bunds to contain the amount of runoff generated by a catchment area. Rainfall depth of 153.12mm

(100-year + 40%CC) was obtained using FEH CDROM, and 40% of this depth (61.25mm) was used for flood volume calculations.

2.06 Runoff volumes were calculated by multiplying this depth (61.25mm) by the plan area of the catchment. For instance, Bunnings North has a covered area of 1734m^2, giving runoff volume of 106.20m^3. Average slope for each catchment measured from the topography was taken into account, and the flood volume exercise has consisted of checking that storage for the volume of runoff (V_{runoff}) can be provided for a bund height, H, and for a bund waterside angle, φ. (Figure 2), ensuring that the bund dimensions are practicable.

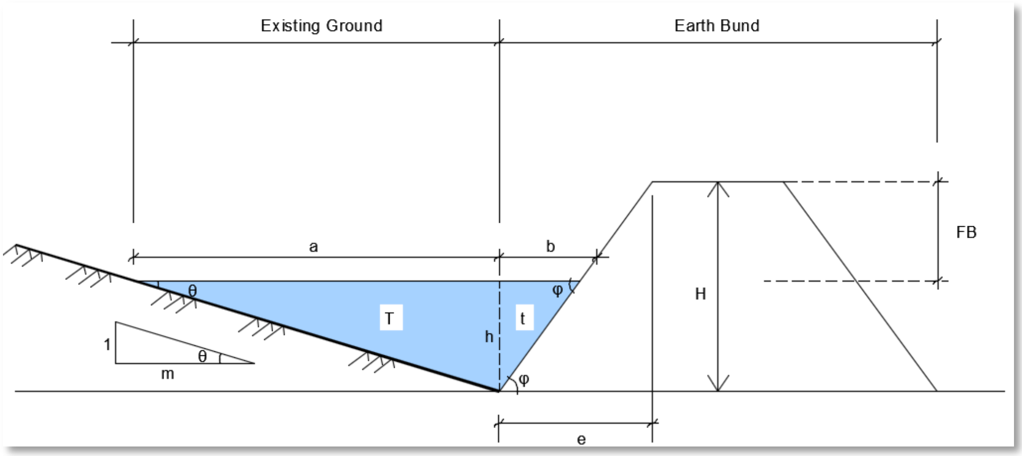


Figure 2: Flood Volume Cross-Section

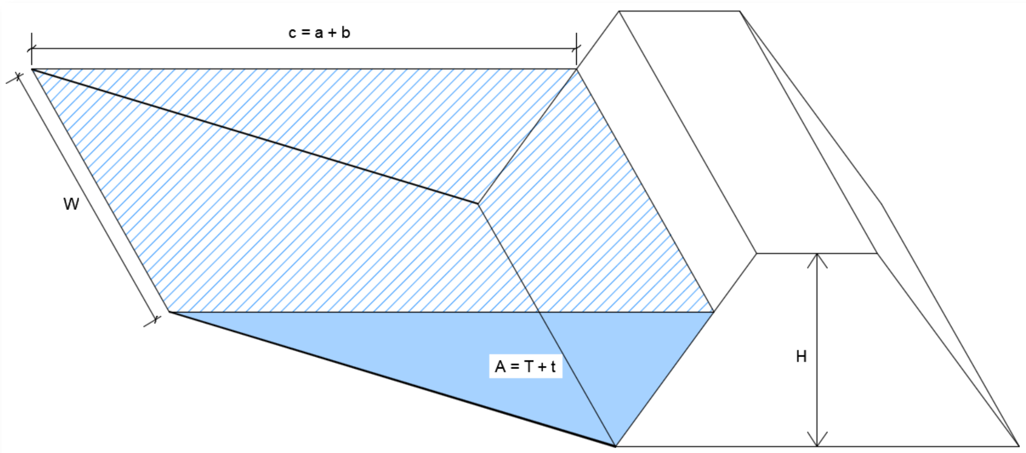


Figure 3: Runoff Volume (3D Visualisation)

2.07 Where heights exceed 1m, consideration may be given to construct a series of bunds to act as check dams along the path of the runoff, this is especially relevant for relatively larger catchment areas (e.g. Swallow Field and Cow Lees). Alternatively, trench soakaways can be built every 50 metres in order to capture more runoff and reduce the amount of runoff volume to provide storage for.

2.08 Trench soakaways with an overflow filter drainpipe at a higher level in the trench will collect rainfall from the outer roofs of the end polytunnels. As water rises in the trench, the collector filter drain will direct water to infiltration basins or geocellular soakaways via catchpit chambers.

2.09 Where land availability for attenuation storage is on a higher ground, a geocellular crated soakaway is proposed, as an open feature such as a basin will be too deep an excavation in the ground for most frequent rainfall events, making them unsafe for farmers. Geocellular crated soakaways are also proposed where there are existing orchards.

2.10 Causeway Flow storm networks simulation attached shows the adequacy of proposed trench soakaways and infiltration basins to manage peak runoff for the critical events, up to the 1 in 100 year storm, allowing for 40% climate change, without any flood. These calculations also show that these SuDS systems half empty within 24 hours.

2.11 Surface water drainage, including Causeway Flow network simulation, can be found in **Appendix D**.

Erosion Control

2.12 Rainfall that falls through the centre polytunnels will land on grass strips in order to minimise any erosion of the soil. Rainfall that falls from the outer roofs of the end polytunnels will land on the gravel of along trench soakaways. This will ensure that soil is not eroded as runoff infiltrate the ground.

3.00 Infiltration

3.01 MAGIC map shows that the proposed development site lies within areas of medium to highly vulnerable groundwater. The Groundwater Vulnerability Map shows the vulnerability of groundwater to a pollutant discharged at ground level based on the hydrological, geological, hydrogeological and soil properties within a single square kilometre.

3.02 The proposal of polytunnels does not add any pollution to the already existing farming activities at these farms. In addition, trench soakaways and infiltration basins will provide a level of treatment in proportion to the type and nature of the proposed development.

3.03 MAGIC groundwater Source Protection Zone map shows that the site lies within zone 3 - total catchment – this zone is defined as an area around a supply source within which all the groundwater ends up at the abstraction point. This is the point from where the water is taken.

3.04 MAGIC maps showing groundwater vulnerability and Source Protection Zone can be found in **Appendix E**.

3.05 In light of the above findings, there are no concerns of groundwater pollution due to the proposed polytunnels and as a result of proposed surface water management hereby discussed in this report. Polytunnels are simply introducing an element of roofing required by farming of certain crops. Surface water at these farms have been draining via infiltration and will continue to do so post-development.

4.00 Maintenance of Trench Soakaways & Filter Drains

4.01 Filter drains are effectively a type of temporary subsurface storage and infiltration soakaway. In addition to their role in allowing infiltration of water, if correctly designed, filter drains can be used to convey water along the SuDS train from one area to another, i.e. capturing water and transporting it to a retention pond further away from the source.

4.02 Typical ongoing maintenance of trench soakaways can be found in *Table 1*:

Table 1: Trench Soakaway and Filter Drain Maintenance Activities

Maintenance Frequency	Actions Required	Maintenance Frequency	Maintenance Effort
Regular Maintenance	Litter and debris removal from trench surface, access chambers and pre-treatment devices.	Monthly for 1st year, then three times per year	1 site visit with 3 men assuming 1 light van, mower and ancillary equipment.
	Remove weeds on the trench surface.	Monthly for 1st year, then three times per year	included within above site visit
	Inspect inlets, outlets and inspection points for blockages, clogging, standing water and structural damage.	Monthly for 1st year, then three times per year	included within above site visit
	Excavate trench walls to expose clean soils if infiltration performance reduces to unacceptable levels. Replace geo-textiles and clean and replace filter media, if clogging occurs.	Every 5 years	Based on filter drain up to 100m length removal of top layer of gravel, clean and replace. Assume 1 site visit with 3 men, 1 light van, small excavator and ancillary equipment.
	Clear perforated pipework blockages.	As required	included within above site visit
Occasional Maintenance	Remove silt from any treatment features upstream of the filter drain	Annually	included within above site visit
	General de-silting of stone fill material within the filter drain	Every 5 years	Based on filter drain up to 100m length removal of top layer of gravel, clean and replace. Assume 1 site visit with 3 men, 1 light van, small excavator and ancillary equipment.
	Inspect pipes and remove any silt build-up by jetting or another appropriate method	As required	Included within above desilting site visit
Reactive Actions	Remove and replace sacrificial geotextile and stone layers to de-silt the surface of the drain.	As required	Based on filter drain up to 100m length removal of top layer of gravel, clean and replace. Assume 1 site visit with 3 men, 1 light van, small excavator and ancillary equipment.

5.00 Maintenance of Geocellular Crate Soakaways

5.01 To ensure the long term effectiveness of the soakaway asset, the sediment that accumulates within the SuDS system must periodically be removed to prevent it from entering the geocellular units and slowing the infiltration of the system. The frequency of this maintenance operation will vary depending on the density of the site, vegetation, design of the drainage system, other permeable areas and if the site is pre or post construction.

5.02 Replacement of the geocellular units will be necessary if the system becomes blocked with silt. Effective monitoring will give information on changes in infiltration rate and provide a warning of potential failure in the long term.

5.03 Maintenance responsibility should be placed with an appropriate organisation, and all maintenance operations are to be carried out in accordance with the manufacturer's recommendations.

Table 2 – Geocellular Crate Units Maintenance Activities

Maintenance Activity	Inspection Frequency
• Inspection for sediments and debris in pre-treatment components and floor of inspection tube or chamber • Cleaning of gutters and any filters on downpipes • Trimming any roots that may be causing blockages	Annually (or as required based on inspections)
• Remove sediment and debris from pre-treatment components and floor of inspection tube or chamber	As required, based on inspections
• Reconstruct soakaway and/or replace or clean void fill, if performance deteriorates or failure occurs • Replacement of clogged geotextile (will require reconstruction of soakaway)	As required
• Inspect silt traps and note rate of sediment accumulation • Check soakaway to ensure emptying is occurring	Annually
• CCTV inspection at every inspection point is recommended	Following all significant storm events

6.00 Maintenance of Infiltration Basins

6.01 Typical ongoing of infiltration basins can be found in *Table 3*.

Table 3: Infiltration Basin Maintenance Activities

Maintenance Frequency	Actions Required	Maintenance Frequency	Maintenance effort
Regular (e.g. Monthly)	Litter and debris removal from site. Clear organic materials in the autumn.	Monthly for 1st year, then three times per year	For surface area of all SuDS less than 1,000m², assume 1 site visit with 3 men assuming 1 light van, mower and ancillary equipment.
	Grass cutting on sides and bed of the basin to 35-50mm lengths except access paths which require 75-100mm length	Every 2 months in the growing season.	
	Inspect and if necessary clear inlet, outlet and overflow openings, and clear if required	Monthly with litter removal	Included in above site visit
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Every 6 months	Included in above site visit
	Pruning and trimming of trees.	Every 2 years	Included in above site visit
	Spiking, scarifying and thatch removal.	Every 3 years (when mulching)	Included in above site visit
	Inspect infiltration surfaces for ponding. Record dewatering time of the facility to determine if maintenance is necessary	Three times per year	Included in above site visit
Occasional (e.g. Seasonal)	Remove silt from basin outlet and invert	As required	
	Weeding	As required (probably annually)	Included in above site visit
Remedial works and Repairs	Remove and replace sacrificial geofabric and stone layers to de-silt the surface of the infiltration trench.	As required	Detention area up to 1000m², assume 1 site visit with 3 men, 1 light van, small excavator and ancillary equipment.
	Inspect and repair any damage to the formal inlets and outlets from the basin	As required	
	Sediment removal and rehabilitation. Removal of damaged or silt covered vegetation to a depth 50mm below original design level.	Every 5 years	Detention area up to 1000m², assume 1 site visit with 3 men, 1 light van, small excavator and ancillary equipment.
	Treatment of diseased trees.	Three times per year, if required	Included in above site visit
	Treatment and restoration of eroded areas.	Three times per year, if required	Included in above site visit
	Re-turfing.	Three times per year, if required	Included in above site visit
	Reinstatement of design levels, restoration or improvement of infiltration and silt removal.	Three times per year, if required	Included in above site visit

Appendix A – Kent County LLFA Comments

Jessica Brown
Canterbury City Council
Planning Department
Military Road,
Canterbury
CT1 1YW

Flood and Water Management
Invicta House
Maidstone
Kent
ME14 1XX
Website: www.kent.gov.uk/flooding
Email: suds@kent.gov.uk
Tel: 03000 41 41 41
Our Ref: CCC/2021/085771
Date: 17 August 2021

Application No: CA/21/01744

Location: Mansfield Farms, Nickle Farm, Nickle Lane, Chartham, Kent, CT4 7PF

Proposal: Erection of polytunnels.

Thank you for your consultation on the above referenced planning application.

Kent County Council as Lead Local Flood Authority have the following comments:

Thank you for consulting us on the above application.

The erection of polytunnels can present three key challenges to flood risk management:

- Increased surface area of impermeable surfaces resulting in increased rates of runoff;
- Displacement of flood flows;
- Soil erosion leading to reduced capacity of watercourse channels downstream.

Given that this site lies within Flood Zone 1, we have no concerns with the displacement of flood waters. However, we do have concerns over the potential for increased rates of runoff and soil erosion, the accompanying Flood Risk Assessment proposes a network of shallow swales and basins at the lower parts of the site to intercept flows from the polytunnels. We will require the submission of additional information at the detailed design stage for these proposals e.g. we will require for it to be demonstrated that 50% of the overall attenuation capacity is available within 24 hours of the determined critical rainfall event.

Should your authority be minded to grant permission to this development, we would therefore recommend that the following Condition is attached:

Condition:
(i) Development shall not begin until a detailed sustainable surface water drainage scheme for the site has been submitted to (and approved in writing by) the local planning authority. The detailed drainage scheme shall be capable of accommodating the surface water generated by this development (for all rainfall durations and intensities up to and including the climate change adjusted critical 100yr storm).
(ii) Development shall not begin until details of the implementation, maintenance and management of the sustainable drainage scheme have been submitted to and approved

in writing by the local planning authority. The scheme shall be implemented and thereafter managed and maintained in accordance with the approved details. Those details shall include:

i) a timetable for its implementation, and

ii) a management and maintenance plan for the lifetime of the development which shall include the arrangements for adoption by any public body or statutory undertaker, or any other arrangements to secure the operation of the sustainable drainage system throughout its lifetime.

Reason:
To ensure that the principles of sustainable drainage are incorporated into this proposal and to ensure ongoing efficacy of the drainage provisions.

Condition:
No building on any phase (or within an agreed implementation schedule) of the development hereby permitted shall be brought into use until a Verification Report, pertaining to the surface water drainage system and prepared by a suitably competent person, has been submitted to and approved by the Local Planning Authority. The Report shall demonstrate that the drainage system constructed is consistent with that which was approved. The Report shall contain information and evidence (including photographs) of details and locations of inlets, outlets and control structures; landscape plans; full as built drawings; information pertinent to the installation of those items identified on the critical drainage assets drawing; and, the submission of an operation and maintenance manual for the sustainable drainage scheme as constructed.

Reason:
To ensure that flood risks from development to the future users of the land and neighbouring land are minimised, together with those risks to controlled waters, property and ecological systems, and to ensure that the development as constructed is compliant with and subsequently maintained pursuant to the requirements of paragraph 165 of the National Planning Policy Framework.

Condition:
Where infiltration is to be used to manage the surface water from the development hereby permitted, it will only be allowed within those parts of the site where information is submitted to demonstrate to the Local Planning Authority's satisfaction that there is no resultant unacceptable risk to controlled waters and/or ground stability. The development shall only then be carried out in accordance with the approved details.

Reason:
To protect vulnerable groundwater resources and ensure compliance with the National Planning Policy Framework.

Should the applicant wish to discuss the above with us prior to the formal submission a Discharge of Condition application, we will be happy to review any proposals in advance.

This response has been provided using the best knowledge and information submitted as part of the planning application at the time of responding and is reliant on the accuracy of that information.

Yours faithfully,

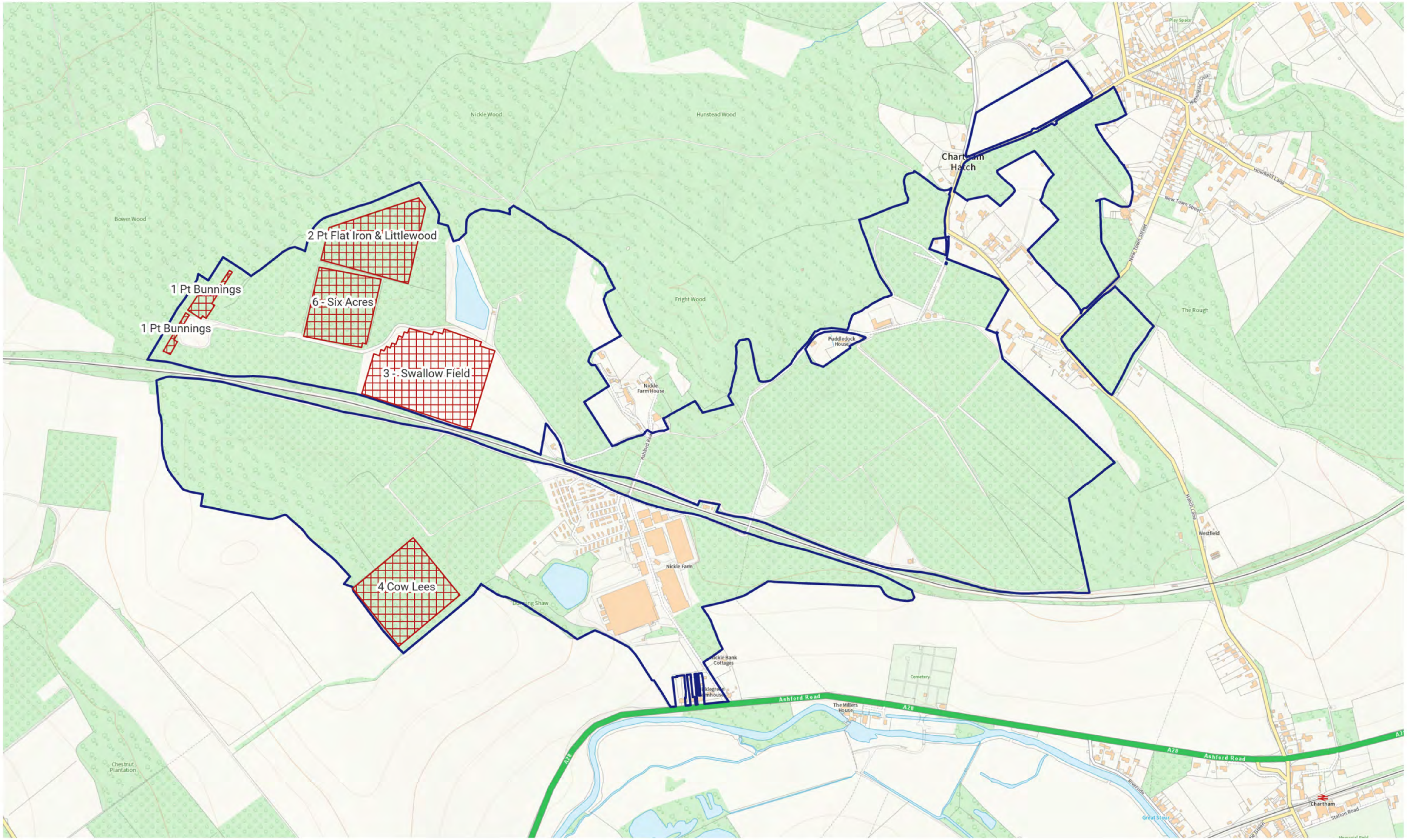
Neil Clarke
Senior Flood Risk Project Officer
Flood and Water Management

Appendix B – Site Location Plan and Development Proposals

FINN'S
since 1865

Location Plan 14_6_21

The land app



Produced on Jun 14, 2021.

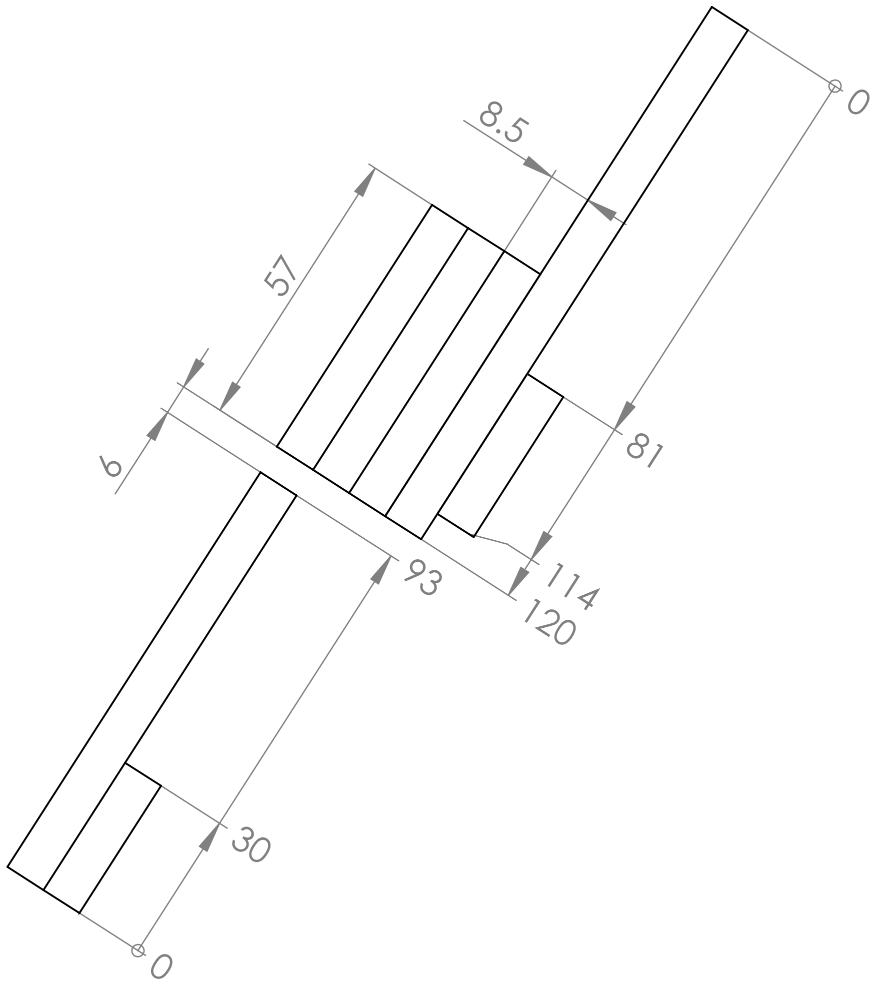
Nickle Farm, Chartham, Canterbury. Ct4 7PF

200 m

Scale 1:7500 (at A3)

N

Block 1
0.4Ha



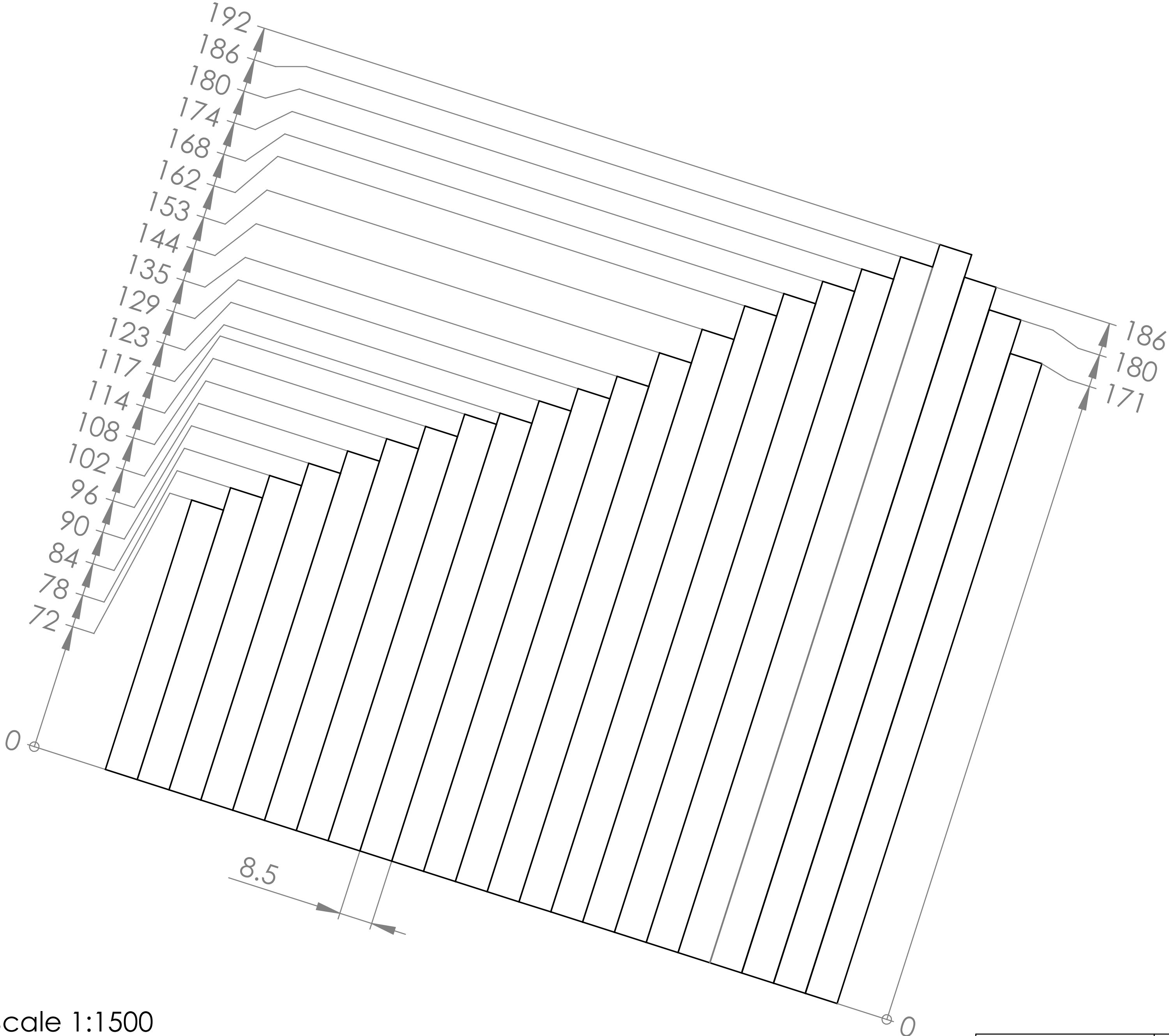
Scale 1:1500

All dimensions in meters

Drawing no:	Block Plans

Haygrove

Block 2
2.2Ha



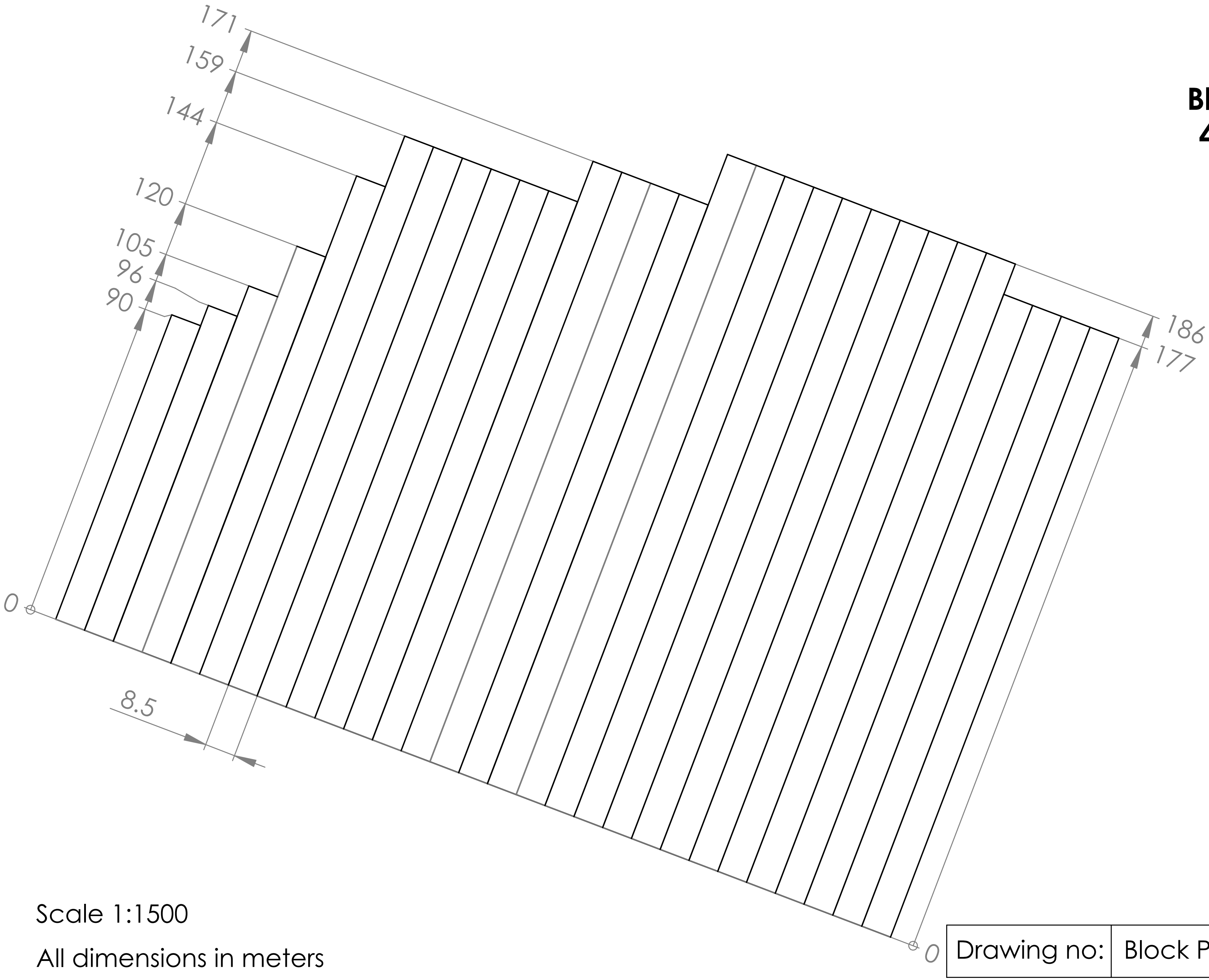
Scale 1:1500

All dimensions in meters

Drawing no:	Block Plans

Haygrove

Block 3
4.4Ha

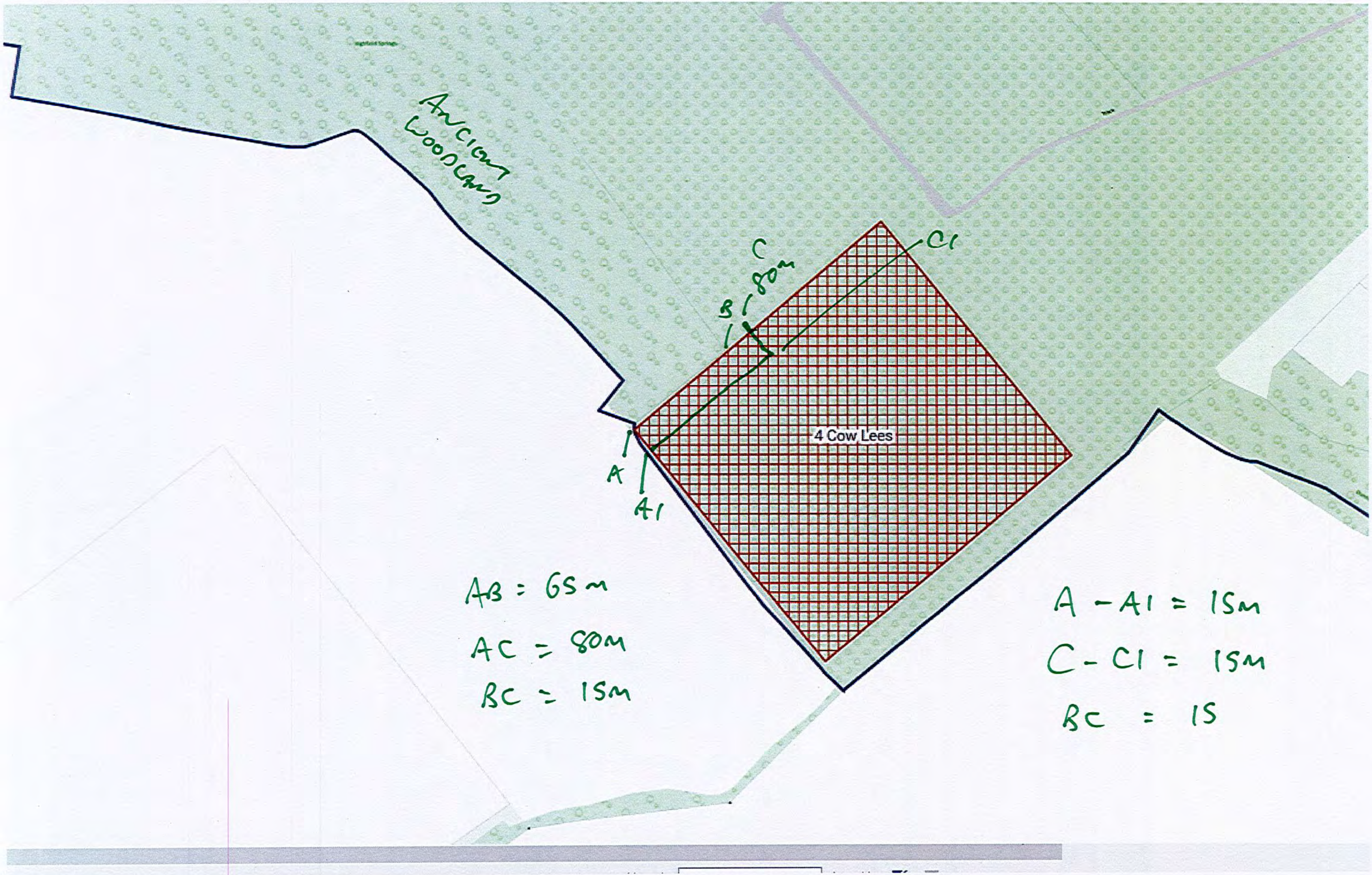


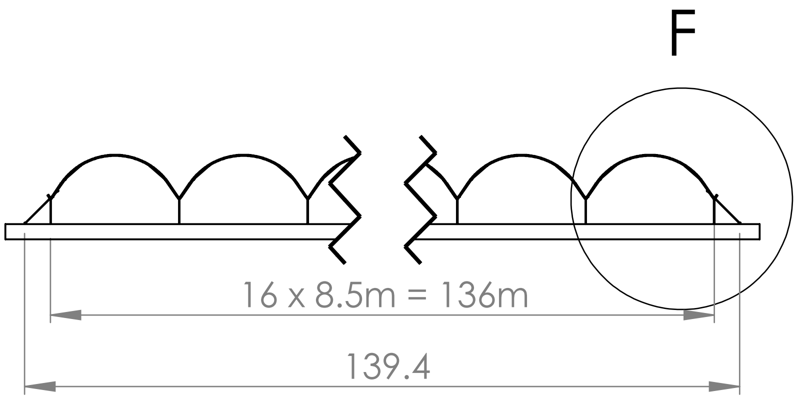
Scale 1:1500

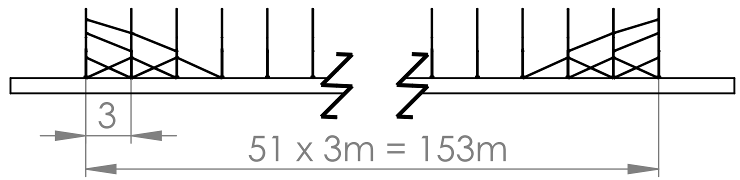
All dimensions in meters

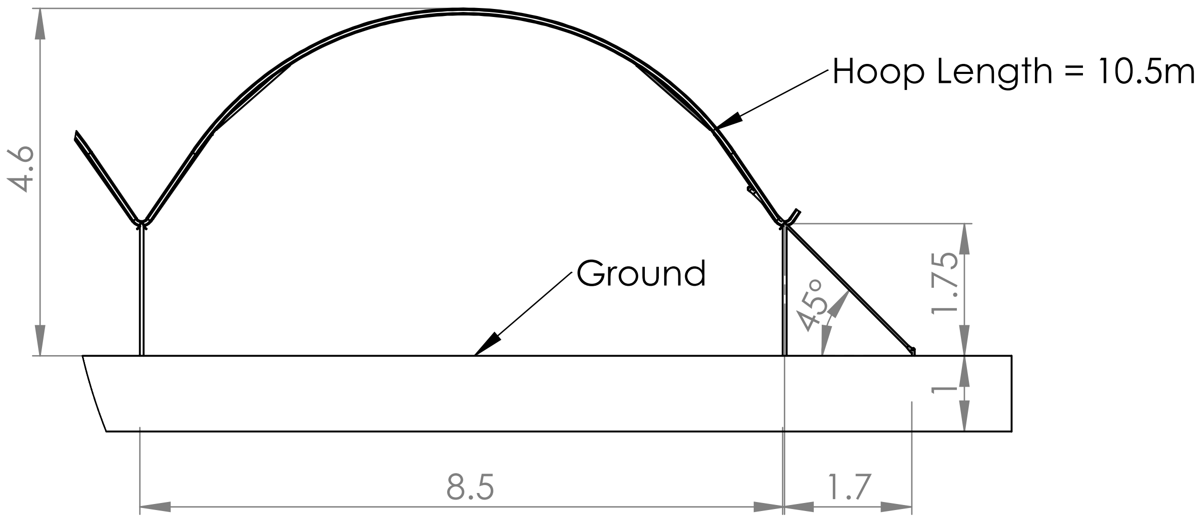
Drawing no:	Block Plans

Haygrove


ANCIENT WOODLAND
4 Cow Lees
A
A1
B
C
C1
80m
AB = 65m
AC = 80m
BC = 15m
A - A1 = 15m
C - C1 = 15m
BC = 15







DETAIL F
SCALE 1 : 100

All dimensions ±5%

All dimensions in meters

Drawing no:	Block Plans

Haygrove

Appendix C – Flood Volume Calculations

Polytunnels Flood Volumes Calculations

Using geometry and trigonometry principles of mathematics

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Project Nickle Farm, Chartham, Canterbury, Kent, CT4 7PF

Job No. 21012

Author C.M.

Checked by M.W.

Verified by G.L.

Revision	Dates	Notes
A	15/10/2021	

Table 1: Rainfall Depth (FEH-99 CDROM)		
Duration	100-year	100-year+40%cc
hours	mm	mm
0.5	42.75	59.85
1	50.44	70.62
2	59.3	83.02
4	69.53	97.34
6	76.25	106.75
10	85.58	119.81
24	109.37	**153.12**

Total water depth (mm)	153.12
40% Runoff depth (mm)	**61.25**

Table 2: Polytunnels Areas				
Polytunnel	**Covered Area (m^2)**	**Runoff Volume (m^3)**	**Avg Slope 1/m**	**Notes**
1. Bunnings North	1734.00	106.20	19.12	
1. Bunnings South	255.00	15.62	24.32	
2. Flat Iron & Littlewood	6014.81	368.39	10.18	Catchment 1
	18044.44	1105.17	22.00	Cathcment 2
3. Swallow Field	38887.94	2381.78	21.00	
4. Cow Lees	27125.00	1661.33	14.28	
6. Six Acres	6568.80	402.32	14.00	Catchment 3
	6568.80	402.32	15.40	Catchment 4
	8758.40	536.43	9.42	Catchment 5

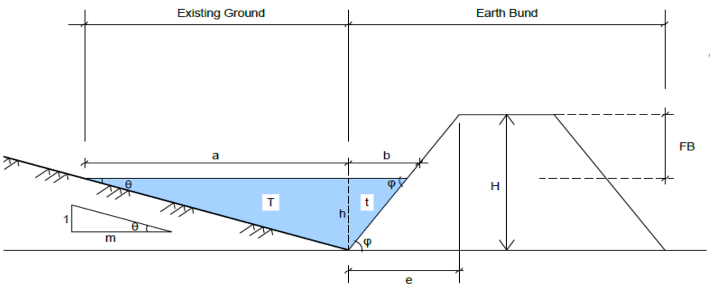


Figure 1

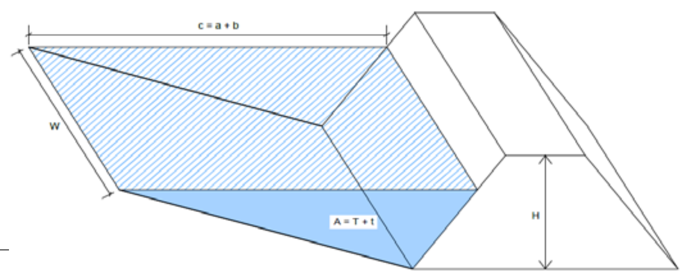


Figure 2

Conditions to meet

We want to check whether volume of runoff, **V_{runoff}**, can be contained by a bund of a certain height, **H**, with the waterside face at an angle, **φ** , given the existing ground slope with a gradient of 1/**m** (measured from the topography).

Calculations

From Figure 2 above,

* **V_{runoff} = A.w** ....(1) Where A = T + t, Figure 1

* **T** = $\frac{1}{2}\,(\boldsymbol{a}.\boldsymbol{h})$ ....(2) Area of a triangle

* **t** = $\frac{1}{2}\,(\boldsymbol{b}.\boldsymbol{h})$ ....(3) Area of a triangle

Add (2) and (3)

* A = $\frac{1}{2}\boldsymbol{h}\,(\boldsymbol{a}+\boldsymbol{b})$ ....(4)

From Figure 1: - $Tan\theta = \frac{h}{a} = \frac{1}{m}$, and Trigonometric ratios

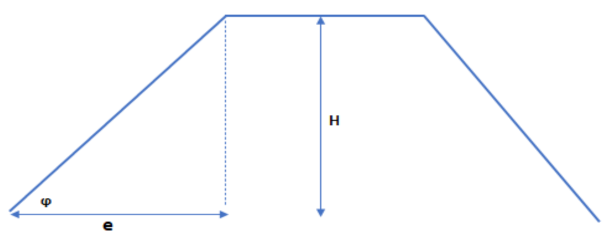
- $Tan\varphi = \frac{h}{b}$, Therefore

* $\boldsymbol{a} = \boldsymbol{hm}$ ....(5)

* $\boldsymbol{b} = \frac{\boldsymbol{h}}{\boldsymbol{Tan\varphi}}$ ....(6)

Substitute (5) and (6) into (4)

* A = $\frac{1}{2}\boldsymbol{h}\left(\boldsymbol{hm} + \frac{\boldsymbol{h}}{\boldsymbol{Tan\varphi}}\right)$ ....(7)

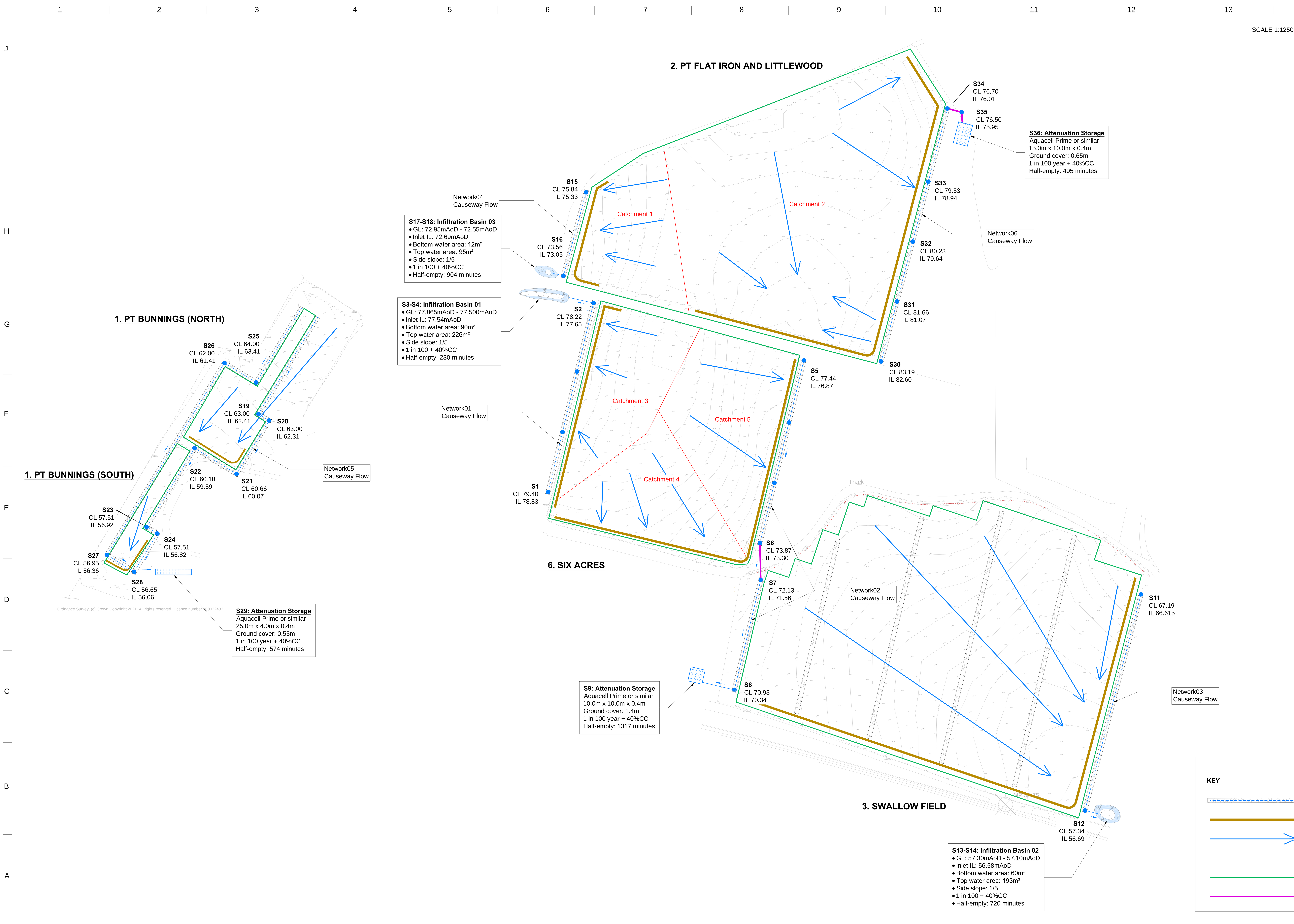


Substitute (7) into (1)

* **V_{runoff}** = $\frac{1}{2}\boldsymbol{wh}\left(\boldsymbol{hm} + \frac{\boldsymbol{h}}{\boldsymbol{Tan\varphi}}\right)$ ....(8)

Table 3: Volume Calculations								
Polytunnels	**V_{runoff} (m^3)**	**Catchment width, w (m)**	**Design h (mm)**	**Ground average Slope, 1/m**	**φ (°)**	**Assume Freeboard, FB (mm)**	**Distance, e (mm)**	**Bund height, H (mm)**
1. Bunnings North	106.20	34.515	550	19.12	39.3	50	734	600
1. Bunnings South	15.62	18.873	250	24.32	24.8	50	648	300
2. Flat Iron & Littlewood	368.39	117.823	750	10.18	46.9	50	750	800
	1105.17	189.971	710	22.00	42.8	50	822	760
3. Swallow Field	2381.78	187.551	1080	21.00	52.2	50	876	1130
4. Cow Lees	1661.33	155.000	1200	14.28	58.8	50	758	1250
6. Six Acres	402.32	163.441	570	14.00	40.9	50	715	620
	402.32	50.014	1000	15.40	55.5	50	723	1050
	536.43	63.608	1300	9.42	60.7	50	756	1350

Appendix D – Proposed Surface Water Drainage & Causeway Networks Simulation Calculations



Notes:

1. Do not scale from this drawing. If in doubt ask.
2. Dimensions are in millimetres unless noted otherwise.
3. These drawings shall be read in conjunction with the Architect's drawings.
4. Setting out is to be in accordance with Architect's drawings.
5. Underground drainage:-

   225mm diameter Hepworth Plastidrain or equivalent PVC-U pipes to BS EN 1401 where noted (final drain from trench soakaway to attenuation storage)

   225mm diameter Hepworth Plastidrain or equivalent PVC-U plain end slotted pipes to BS EN 1401 where noted.
6. Trench soakaways to have overflow slotted piped to convey water to an infiltration basin or geocellular soakaway.
7. Catchpit chamber to be installed every 43-45m along the trench soakaway.
8. Cover and Invert Levels are shown are rounded to 2 decimal places (3 decimal places in Causeway Simulation Calculations).
9. Some manholes have been used to define attenuation storages (eg. S13 & 14 define Flow Through Pond for Network03). S10 is omitted.
10. Where CL and IL are not given for some chambers along the trench soakaways, these chambers will take cover levels from ground levels, invert levels to be extrapolated between the two end chambers
11. For earth bund dimensions, see document "21012 - Flood Volumes Calculations", Appendix C of Surface Water Drainage Statement

KEY

- SOAKAWAY TRENCH /FILTER DRAIN WITH CATCHPIT CHAMBER
- EARTH BUND
- RUNOFF (GROUND FALL)
- DRAINAGE CATCHMENT DELINEATION
- APPROXIMATE POLYTUNNEL BOUNDARY
- CONCRETE PIPE (UNDER VEHICULAR ACCESS)

Notes:

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT MONSON DRAWINGS AND SPECIFICATIONS, ANY DISCREPANCIES TO BE REPORTED TO MONSON PRIOR TO ANY FABRICATION OR WORK COMMENCING ON SITE.
2. DO NOT SCALE THIS DRAWING, USE FIGURED DIMENSIONS ONLY.
3. ALL DIMENSIONS IN MILLIMETRES, ALL LEVELS IN METRES.

Issue	By	Date	Amendments
A	CM	15/10/2021	Original Issue

MONSON

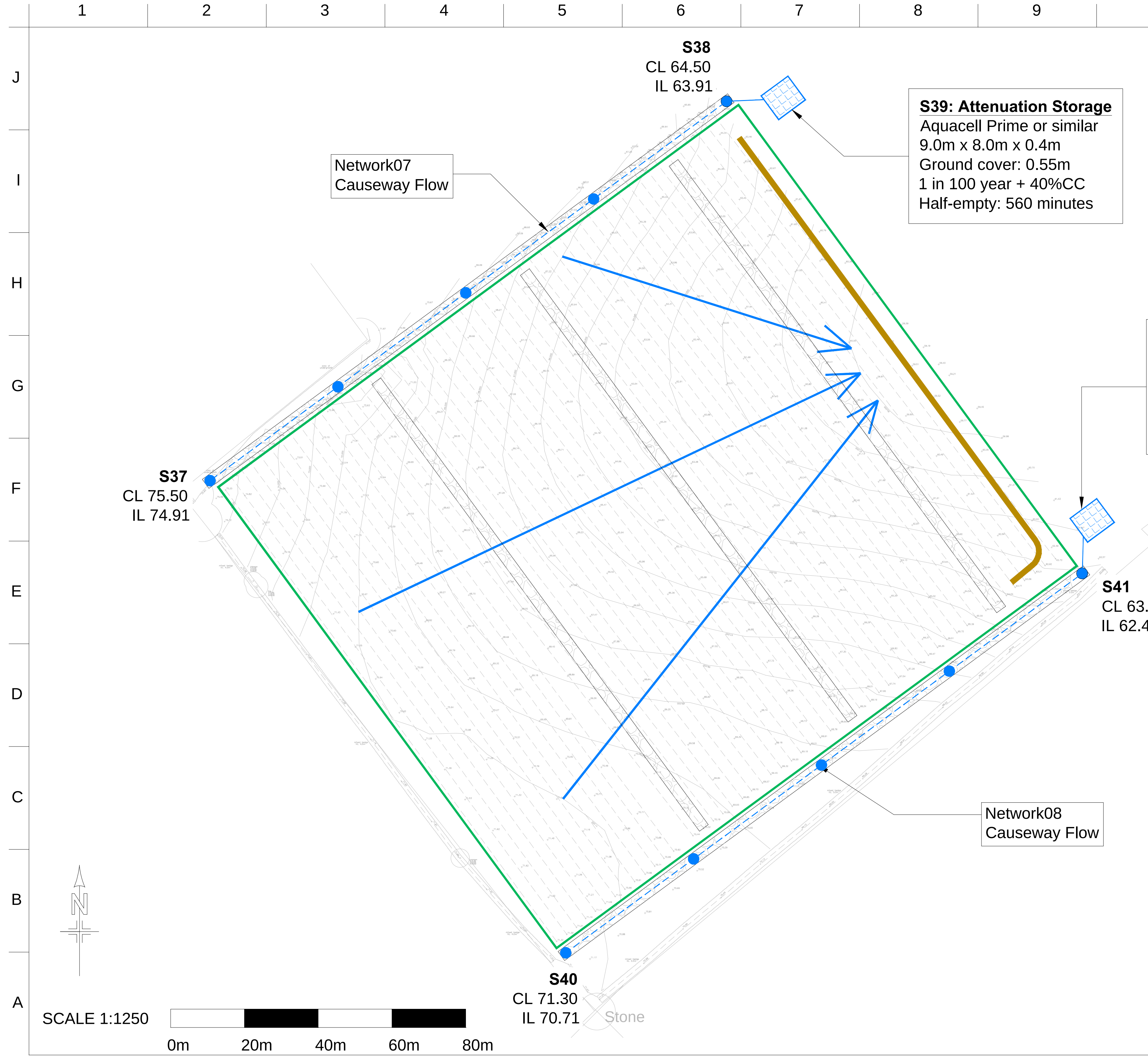
Broadway Chambers, High Street, Crowborough, East Sussex TN6 1DF
Tel: (01892) 601370
E-mail: enquiries@monson.co.uk

Project:
Nickle Farm
Chartham
Canterbury
Kent CT4 7PF

Description:
Proposed Drainage Layout
Surface Water Drainage for:
1. Pt Bunnings, 2. Flat Iron & Littl.,
3. Swallow Field & 6. Six Acres

Original Drawing: Prepared CM Approved GL
Origin: Crowborough Size A1
Current Issue: Approved GL Date 15/10/2021
Drawing Status: PLANNING

Scale: 1:1250
Dwg No: 21012/01
Issue: A



Notes:

1. Do not scale from this drawing. If in doubt ask.

2. Underground drainage:-

   225mm diameter Hepworth Plastidrain or equivalent PVC-U pipes to BS EN 1401 where noted (final drain from trench soakaway to attenuation storage).

   225mm diameter Hepworth Plastidrain or equivalent PVC-U plain end slotted pipes to BS EN 1401 where noted.

3. Trench soakaways to have overflow slotted piped to convey water to an infiltration basin or geocellular soakaway.

4. Catchpit chamber to be installed every 43-45m along the trench soakaway.

5. Cover and Invert Levels are shown are rounded to 2 decimal places (3 decimal places in Causeway Simulation Calculations).

6. Some manholes have been used to define attenuation storages (eg. S13 & 14 define Flow Through Pond for Network03). S10 is omitted.

7. Where CL and IL are not given for some chambers along the trench soakaways, these chambers will take cover levels from ground levels, invert levels to be extrapolated between the two end chambers

SOAKAWAY TRENCH /FILTER DRAIN WITH CATCHPIT CHAMBER

EARTH BUND

RUNOFF (GROUND FALL)

APPROXIMATE POLYTUNNEL BOUNDARY

Notes:
1. This drawing to be read in conjunction with all other relevant Monson drawings and specifications, any discrepancies to be reported to Monson prior to any fabrication or work commencing on site.

2. Do not scale this drawing use figured dimensions only

3. All dimensions in millimetres, all levels in metres.

Issue	By	Date	Amendments
A	CM	15/10/2021	Original Issue

MONSON

Broadway Chambers, High Street, Crowborough, East Sussex TN6 1DF
Tel: (01892) 601370
E-mail: enquiries@monson.co.uk

Project:
Nickle Farm
Chartham
Canterbury
CT4 7PF

Description:
Proposed Drainage Layout
Surface Water Drainage for:
4. Cow Lees

Original Drawing:	Prepared	CM	Approved	GL	
Origin:	Crowborough		Size	A3	
Current Issue:	Approved	GL	Date	15/10/2021	
Drawing Status:	PLANNING				

Scale:	Dwg No:	Issue:
1:1250	21012/02	A

MEL 84 APPROVED OCT/2011 ISSUE No. 5

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	1	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	26.250	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	0.350
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
S1	0.033	5.00	79.400	600	0.575
S2	0.033	5.00	78.220	600	0.575
S3			77.865		0.930
S4			77.500		0.625

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	S1	S2	135.000	0.600	78.825	77.645	1.180	114.4	225	6.84	50.0
1.001	S2	S3	17.719	0.600	77.645	77.540	0.105	168.8	225	7.14	50.0

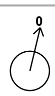
Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1.221	48.6	4.5	0.350	0.350	0.033	0.0	46	0.769
1.001	1.003	39.9	8.9	0.350	0.100	0.066	0.0	73	0.814

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	135.000	114.4	225	Circular	79.400	78.825	0.350	78.220	77.645	0.350
1.001	17.719	168.8	225	Circular	78.220	77.645	0.350	77.865	77.540	0.100

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	S1	600	Manhole	Adoptable	S2	600	Manhole	Adoptable
1.001	S2	600	Manhole	Adoptable	S3		Junction	

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S1	608525.496	156254.324	79.400	0.575	600	 0	1.000	78.825	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S2	608557.048	156385.585	78.220	0.575	600	1	1.000	77.645	225
						0	1.001	77.645	225
S3	608539.757	156389.456	77.865	0.930		1	1.001	77.540	225
S4	608511.731	156389.960	77.500	0.625					

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Detailed
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	26.500	Drain Down Time (mins)	1440
Ratio-R	0.400	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	40	0	0

Node S4 Flow through Pond Storage Structure

Base Inf Coefficient (m/hr)	0.04100	Porosity	1.00	Main Channel Length (m)	30.000
Side Inf Coefficient (m/hr)	0.04100	Invert Level (m)	76.875	Main Channel Slope (1:X)	500.0
Safety Factor	1.5	Time to half empty (mins)	230	Main Channel n	0.030

Inlets
S3

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	90.0	100.0	0.625	225.8	288.9	0.626	226.0	288.9

Node S2 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.04100	Porosity	0.30	Link	1.000
Side Inf Coefficient (m/hr)	0.04100	Invert Level (m)	77.220	Surround Shape	(Trench)
Safety Factor	1.5	Time to half empty (mins)	46	Diameter (mm)	600

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.70%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute summer	S1	18	78.934	0.109	23.9	0.1560	0.0000	OK
30 minute summer	S2	19	77.838	0.193	47.2	4.0937	0.0000	OK
120 minute winter	S3	122	77.194	0.258	15.9	0.0000	0.0000	OK
120 minute winter	S4	122	77.194	0.319	8.7	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
30 minute summer	S1	1.000	S2	23.3	0.886	0.481	3.7128
30 minute summer	S2	1.001	S3	41.1	1.200	1.030	0.6069
30 minute summer	S2	Infiltration		0.8			
120 minute winter	S3	Flow through pond	S4	8.7	0.076	0.002	35.1467
120 minute winter	S4	Infiltration		1.4			

Design Settings

Rainfall Methodology	FSR
Return Period (years)	1
Additional Flow (%)	0
FSR Region	England and Wales
M5-60 (mm)	26.250
Ratio-R	0.400
CV	0.750
Time of Entry (mins)	5.00

Maximum Time of Concentration (mins)	30.00
Maximum Rainfall (mm/hr)	50.0
Minimum Velocity (m/s)	1.00
Connection Type	Level Soffits
Minimum Backdrop Height (m)	0.200
Preferred Cover Depth (m)	0.350
Include Intermediate Ground	✓
Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
S5	0.031	5.00	77.440	600	0.575
S6	0.031	5.00	73.870	600	0.625
S7	0.020	5.00	72.130	600	0.575
S8	0.020	5.00	70.930	600	0.590
S9			72.000		1.765

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	S5	S6	130.403	0.600	76.865	73.295	3.570	36.5	150	6.30	50.0
1.001	S6	S7	25.613	0.600	73.245	71.555	1.690	15.2	225	6.43	50.0
1.002	S7	S8	78.520	0.600	71.555	70.340	1.215	64.6	225	7.23	50.0
1.003	S8	S9	22.890	0.600	70.340	70.235	0.105	218.0	225	7.66	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1.670	29.5	4.2	0.425	0.425	0.031	0.0	38	1.191
1.001	3.378	134.3	8.4	0.400	0.350	0.062	0.0	38	1.910
1.002	1.629	64.8	11.1	0.350	0.365	0.082	0.0	63	1.225
1.003	0.881	35.0	13.8	0.365	1.540	0.102	0.0	98	0.830

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	130.403	36.5	150	Circular	77.440	76.865	0.425	73.870	73.295	0.425
1.001	25.613	15.2	225	Circular	73.870	73.245	0.400	72.130	71.555	0.350
1.002	78.520	64.6	225	Circular	72.130	71.555	0.350	70.930	70.340	0.365
1.003	22.890	218.0	225	Circular	70.930	70.340	0.365	72.000	70.235	1.540

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	S5	600	Manhole	Adoptable	S6	600	Manhole	Adoptable
1.001	S6	600	Manhole	Adoptable	S7	600	Manhole	Adoptable
1.002	S7	600	Manhole	Adoptable	S8	600	Manhole	Adoptable
1.003	S8	600	Manhole	Adoptable	S9		Junction	

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S5	608703.088	156345.752	77.440	0.575	600	0	1.000	76.865	150
S6	608672.610	156218.961	73.870	0.625	600	1	1.000	73.295	150
						0	1.001	73.245	225
S7	608673.191	156193.355	72.130	0.575	600	1	1.001	71.555	225
						0	1.002	71.555	225
S8	608654.840	156117.010	70.930	0.590	600	1	1.002	70.340	225
						0	1.003	70.340	225
S9	608632.567	156122.290	72.000	1.765		1	1.003	70.235	225

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Detailed
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	26.250	Drain Down Time (mins)	1440
Ratio-R	0.400	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	40	0	0

Node S6 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.04100	Porosity	0.30	Link	1.000
Side Inf Coefficient (m/hr)	0.04100	Invert Level (m)	72.870	Surround Shape	(Trench)
Safety Factor	1.5	Time to half empty (mins)	7	Diameter (mm)	600

Node S8 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.04100	Porosity	0.30	Link	1.002
Side Inf Coefficient (m/hr)	0.04100	Invert Level (m)	69.930	Surround Shape	(Trench)
Safety Factor	1.5	Time to half empty (mins)	704	Diameter (mm)	600

Node S9 Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.04100	Invert Level (m)	70.235	Depth (m)	
Side Inf Coefficient (m/hr)	0.04100	Time to half empty (mins)	1317	Inf Depth (m)	0.400
Safety Factor	1.5	Pit Width (m)	10.000	Number Required	1
Porosity	0.95	Pit Length (m)	10.000		

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.49%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute summer	S5	18	76.960	0.095	22.2	0.1295	0.0000	OK
30 minute summer	S6	18	73.332	0.087	43.4	0.8132	0.0000	OK
30 minute summer	S7	18	71.716	0.161	57.3	0.1574	0.0000	OK
240 minute winter	S8	236	70.844	0.504	14.9	5.1487	0.0000	FLOOD RISK
240 minute winter	S9	236	70.844	0.609	12.7	57.8519	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
30 minute summer	S5	1.000	S6	21.2	1.816	0.718	1.5257
30 minute summer	S6	1.001	S7	43.0	1.927	0.320	0.5709
30 minute summer	S6	Infiltration		0.2			
30 minute summer	S7	1.002	S8	56.5	1.490	0.873	2.7545
240 minute winter	S8	1.003	S9	12.7	0.927	0.362	0.9104
240 minute winter	S8	Infiltration		0.7			
240 minute winter	S9	Infiltration		0.9			

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	1	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	26.250	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	0.350
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
S11	0.038	5.00	67.190	600	0.575
S12	0.038	5.00	57.340	600	0.650
S13			57.300		0.875
S14			57.100		0.695

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	S11	S12	155.000	0.600	66.615	56.765	9.850	15.7	150	6.01	50.0
1.001	S12	S13	11.075	0.600	56.690	56.580	0.110	100.7	225	6.15	50.0

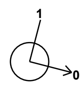
Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	2.552	45.1	5.1	0.425	0.425	0.038	0.0	34	1.707
1.001	1.303	51.8	10.3	0.425	0.495	0.076	0.0	68	1.023

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	155.000	15.7	150	Circular	67.190	66.615	0.425	57.340	56.765	0.425
1.001	11.075	100.7	225	Circular	57.340	56.690	0.425	57.300	56.580	0.495

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	S11	600	Manhole	Adoptable	S12	600	Manhole	Adoptable
1.001	S12	600	Manhole	Adoptable	S13		Junction	

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
S11	608937.268	156183.361	67.190	0.575	600		0	1.000	66.615	150
S12	608898.365	156033.322	57.340	0.650	600		1	1.000	56.765	150
							0	1.001	56.690	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S13	608909.086	156030.543	57.300	0.875		1	1.001	56.580	225
S14	608956.966	156022.246	57.100	0.695					

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Detailed
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	26.250	Drain Down Time (mins)	1440
Ratio-R	0.400	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	40	0	0

Node S14 Flow through Pond Storage Structure

Base Inf Coefficient (m/hr)	0.04100	Porosity	1.00	Main Channel Length (m)	10.000
Side Inf Coefficient (m/hr)	0.04100	Invert Level (m)	56.405	Main Channel Slope (1:X)	500.0
Safety Factor	1.5	Time to half empty (mins)	720	Main Channel n	0.030

Inlets

S13

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	60.0	60.0	0.695	193.4	144.0	0.696	193.6	144.0

Node S12 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.04100	Porosity	0.30	Link	1.000
Side Inf Coefficient (m/hr)	0.04100	Invert Level (m)	56.340	Surround Shape	(Trench)
Safety Factor	1.5	Time to half empty (mins)	0	Diameter (mm)	600

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.78%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m^3)	Flood (m^3)	Status
30 minute summer	S11	18	66.699	0.084	27.2	0.1346	0.0000	OK
360 minute winter	S12	352	56.899	0.209	8.2	0.7423	0.0000	OK
360 minute winter	S13	352	56.899	0.474	8.1	0.0000	0.0000	OK
360 minute winter	S14	352	56.899	0.494	4.4	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m^3)
30 minute summer	S11	1.000	S12	27.1	2.386	0.601	2.0628
360 minute winter	S12	1.001	S13	8.1	0.875	0.156	0.4335
360 minute winter	S12	Infiltration		0.1			
360 minute winter	S13	Flow through pond	S14	4.4	0.034	0.000	51.5773
360 minute winter	S14	Infiltration		0.9			

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	1	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	26.250	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	0.350
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
S15	0.015	5.00	75.840	600	0.510
S16	0.015	5.00	73.560	600	0.510
S17			72.950		1.102
S18			72.550		0.710

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	S15	S16	59.999	0.600	75.330	73.050	2.280	26.3	100	5.66	50.0
1.001	S16	S17	8.860	0.600	73.050	72.690	0.360	24.6	100	5.76	50.0

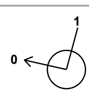
Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1.510	11.9	2.0	0.410	0.410	0.015	0.0	28	1.122
1.001	1.562	12.3	4.1	0.410	0.160	0.030	0.0	39	1.400

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	59.999	26.3	100	Circular	75.840	75.330	0.410	73.560	73.050	0.410
1.001	8.860	24.6	100	Circular	73.560	73.050	0.410	72.950	72.690	0.160

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	S15	600	Manhole	Adoptable	S16	600	Manhole	Adoptable
1.001	S16	600	Manhole	Adoptable	S17		Junction	

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
S15	608551.879	156462.474	75.840	0.510	600		0	1.000	75.330	100
S16	608536.180	156404.565	73.560	0.510	600		1	1.000	73.050	100
							0	1.001	73.050	100

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S17	608527.534	156406.501	72.950	1.102		1	1.001	72.690	100
S18	608517.750	156408.565	72.550	0.710					

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Detailed
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	26.250	Drain Down Time (mins)	1440
Ratio-R	0.400	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	40	0	0

Node S16 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.04100	Porosity	0.30	Link	1.000
Side Inf Coefficient (m/hr)	0.04100	Invert Level (m)	72.560	Surround Shape	(Trench)
Safety Factor	1.5	Time to half empty (mins)	91	Diameter (mm)	600

Node S18 Flow through Pond Storage Structure

Base Inf Coefficient (m/hr)	0.04100	Porosity	1.00	Main Channel Length (m)	4.000
Side Inf Coefficient (m/hr)	0.04100	Invert Level (m)	71.840	Main Channel Slope (1:X)	500.0
Safety Factor	1.5	Time to half empty (mins)	904	Main Channel n	0.030

Inlets
S17

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	12.0	12.0	0.710	95.2	50.3	0.711	95.4	50.3

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 98.96%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute summer	S15	18	75.405	0.075	10.7	0.0649	0.0000	OK
30 minute summer	S16	20	73.444	0.394	21.4	2.1816	0.0000	FLOOD RISK
360 minute winter	S17	344	72.324	0.476	3.0	0.0000	0.0000	OK
360 minute winter	S18	344	72.324	0.484	1.6	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
30 minute summer	S15	1.000	S16	10.7	1.416	0.901	0.4224
30 minute summer	S16	1.001	S17	15.6	1.995	1.272	0.0693
30 minute summer	S16	Infiltration		0.3			
360 minute winter	S17	Flow through pond	S18	1.6	0.007	0.000	19.3143
360 minute winter	S18	Infiltration		0.3			

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	1	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	26.250	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	0.350
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
J1	0.017	5.00	66.320		0.590
S19			63.000	600	0.590
S20	0.007	5.00	63.000	600	0.690
S21	0.003	5.00	60.660	600	0.590
S22	0.014	5.00	60.180	600	0.590
S23			57.510	600	0.590
S24	0.013	5.00	57.510	600	0.690
J2	0.014	5.00	66.000		0.590
S25			64.000	600	0.590
S26	0.024	5.00	62.000	600	0.590
S27			56.950	600	0.590
S28			56.740	600	0.680
S29			56.690		0.785

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	J1	S19	78.992	0.600	65.730	62.410	3.320	23.8	225	5.49	50.0
1.001	S19	S20	8.747	0.600	62.410	62.310	0.100	87.5	225	5.59	50.0
1.002	S20	S21	43.366	0.600	62.310	60.070	2.240	19.4	225	5.84	50.0
1.003	S21	S22	34.195	0.600	60.070	59.590	0.480	71.2	225	6.20	50.0
1.004	S22	S23	64.076	0.600	59.590	56.920	2.670	24.0	225	6.60	50.0
1.005	S23	S24	8.741	0.600	56.920	56.820	0.100	87.4	225	6.70	50.0
1.006	S24	S28	31.160	0.600	56.820	56.060	0.760	41.0	225	6.96	50.0
2.000	J2	S25	61.124	0.600	65.410	63.410	2.000	30.6	225	5.43	50.0
2.001	S25	S26	25.863	0.600	63.410	61.410	2.000	12.9	225	5.55	50.0
2.002	S26	S27	156.183	0.600	61.410	56.360	5.050	30.9	225	6.65	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	2.693	107.1	4.6	0.365	0.365	0.034	0.0	31	1.344
1.001	1.399	55.6	4.6	0.365	0.465	0.034	0.0	44	0.852
1.002	2.987	118.8	6.5	0.465	0.365	0.048	0.0	36	1.617
1.003	1.551	61.7	6.9	0.365	0.365	0.051	0.0	51	1.032
1.004	2.682	106.6	8.8	0.365	0.365	0.065	0.0	44	1.637
1.005	1.399	55.6	8.8	0.365	0.465	0.065	0.0	60	1.027
1.006	2.049	81.5	10.6	0.465	0.455	0.078	0.0	54	1.417
2.000	2.375	94.4	1.9	0.365	0.365	0.014	0.0	22	0.960
2.001	3.658	145.4	1.9	0.365	0.365	0.014	0.0	18	1.287
2.002	2.361	93.9	10.6	0.365	0.365	0.078	0.0	51	1.572

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
2.003	S27	S28	22.197	0.600	56.360	56.060	0.300	74.0	225	6.89	50.0
2.004	S28	S29	15.000	0.600	56.060	55.905	0.155	96.8	225	7.15	50.0

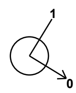
Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
2.003	1.522	60.5	10.6	0.365	0.455	0.078	0.0	64	1.153
2.004	1.329	52.8	21.1	0.455	0.560	0.156	0.0	99	1.257

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	78.992	23.8	225	Circular	66.320	65.730	0.365	63.000	62.410	0.365
1.001	8.747	87.5	225	Circular	63.000	62.410	0.365	63.000	62.310	0.465
1.002	43.366	19.4	225	Circular	63.000	62.310	0.465	60.660	60.070	0.365
1.003	34.195	71.2	225	Circular	60.660	60.070	0.365	60.180	59.590	0.365
1.004	64.076	24.0	225	Circular	60.180	59.590	0.365	57.510	56.920	0.365
1.005	8.741	87.4	225	Circular	57.510	56.920	0.365	57.510	56.820	0.465
1.006	31.160	41.0	225	Circular	57.510	56.820	0.465	56.740	56.060	0.455
2.000	61.124	30.6	225	Circular	66.000	65.410	0.365	64.000	63.410	0.365
2.001	25.863	12.9	225	Circular	64.000	63.410	0.365	62.000	61.410	0.365
2.002	156.183	30.9	225	Circular	62.000	61.410	0.365	56.950	56.360	0.365
2.003	22.197	74.0	225	Circular	56.950	56.360	0.365	56.740	56.060	0.455
2.004	15.000	96.8	225	Circular	56.740	56.060	0.455	56.690	55.905	0.560

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	J1		Junction		S19	600	Manhole	Adoptable
1.001	S19	600	Manhole	Adoptable	S20	600	Manhole	Adoptable
1.002	S20	600	Manhole	Adoptable	S21	600	Manhole	Adoptable
1.003	S21	600	Manhole	Adoptable	S22	600	Manhole	Adoptable
1.004	S22	600	Manhole	Adoptable	S23	600	Manhole	Adoptable
1.005	S23	600	Manhole	Adoptable	S24	600	Manhole	Adoptable
1.006	S24	600	Manhole	Adoptable	S28	600	Manhole	Adoptable
2.000	J2		Junction		S25	600	Manhole	Adoptable
2.001	S25	600	Manhole	Adoptable	S26	600	Manhole	Adoptable
2.002	S26	600	Manhole	Adoptable	S27	600	Manhole	Adoptable
2.003	S27	600	Manhole	Adoptable	S28	600	Manhole	Adoptable
2.004	S28	600	Manhole	Adoptable	S29		Junction	

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
J1	608365.542	156375.904	66.320	0.590			0	1.000	65.730	225
S19	608324.317	156308.523	63.000	0.590	600		1	1.000	62.410	225
							0	1.001	62.410	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S20	608331.778	156303.958	63.000	0.690	600	1	1.001	62.310	225
						0	1.002	62.310	225
S21	608309.146	156266.966	60.660	0.590	600	1	1.002	60.070	225
						0	1.003	60.070	225
S22	608279.977	156284.812	60.180	0.590	600	1	1.003	59.590	225
						0	1.004	59.590	225
S23	608246.664	156230.076	57.510	0.590	600	1	1.004	56.920	225
						0	1.005	56.920	225
S24	608254.131	156225.532	57.510	0.690	600	1	1.005	56.820	225
						0	1.006	56.820	225
J2	608354.613	156382.590	66.000	0.590		0	2.000	65.410	225
S25	608322.713	156330.451	64.000	0.590	600	1	2.000	63.410	225
						0	2.001	63.410	225
S26	608300.652	156343.949	62.000	0.590	600	1	2.001	61.410	225
						0	2.002	61.410	225
S27	608219.141	156210.723	56.950	0.590	600	1	2.002	56.360	225
						0	2.003	56.360	225
S28	608237.935	156198.912	56.740	0.680	600	1	2.003	56.060	225
						2	1.006	56.060	225
						0	2.004	56.060	225
S29	608252.935	156198.878	56.690	0.785		1	2.004	55.905	225

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Detailed
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	26.250	Drain Down Time (mins)	1440
Ratio-R	0.400	Additional Storage (m^3/ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	40	0	0

Node S19 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.04100	Porosity	0.30	Link	1.000
Side Inf Coefficient (m/hr)	0.04100	Invert Level (m)	62.000	Surround Shape	(Trench)
Safety Factor	1.5	Time to half empty (mins)	17	Diameter (mm)	600

Node S20 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.04100	Porosity	0.30	Link	1.001
Side Inf Coefficient (m/hr)	0.04100	Invert Level (m)	62.000	Surround Shape	(Trench)
Safety Factor	1.5	Time to half empty (mins)	84	Diameter (mm)	600

Node S21 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.04100	Porosity	0.30	Link	1.002
Side Inf Coefficient (m/hr)	0.04100	Invert Level (m)	59.660	Surround Shape	(Trench)
Safety Factor	1.5	Time to half empty (mins)	32	Diameter (mm)	600

Node S22 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.04100	Porosity	0.30	Link	1.003
Side Inf Coefficient (m/hr)	0.04100	Invert Level (m)	59.180	Surround Shape	(Trench)
Safety Factor	1.5	Time to half empty (mins)	56	Diameter (mm)	600

Node S23 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.04100	Porosity	0.30	Link	1.004
Side Inf Coefficient (m/hr)	0.04100	Invert Level (m)	56.510	Surround Shape	(Trench)
Safety Factor	1.5	Time to half empty (mins)	3	Diameter (mm)	600

Node S24 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.04100	Porosity	0.30	Link	1.005
Side Inf Coefficient (m/hr)	0.04100	Invert Level (m)	56.510	Surround Shape	(Trench)
Safety Factor	1.5	Time to half empty (mins)	91	Diameter (mm)	600

Node S28 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.04100	Porosity	0.30	Link	1.006
Side Inf Coefficient (m/hr)	0.04100	Invert Level (m)	55.650	Surround Shape	(Trench)
Safety Factor	1.5	Time to half empty (mins)	376	Diameter (mm)	600

Node S25 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.04100	Porosity	0.30	Link	2.000
Side Inf Coefficient (m/hr)	0.04100	Invert Level (m)	63.000	Surround Shape	(Trench)
Safety Factor	1.5	Time to half empty (mins)	0	Diameter (mm)	600

Node S26 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.04100	Porosity	0.30	Link	2.001
Side Inf Coefficient (m/hr)	0.04100	Invert Level (m)	61.000	Surround Shape	(Trench)
Safety Factor	1.5	Time to half empty (mins)	4	Diameter (mm)	600

Node S27 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.04100	Porosity	0.30	Link	2.002
Side Inf Coefficient (m/hr)	0.04100	Invert Level (m)	55.950	Surround Shape	(Trench)
Safety Factor	1.5	Time to half empty (mins)	5	Diameter (mm)	600

Node S28 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.04100	Porosity	0.30	Link	2.003
Side Inf Coefficient (m/hr)	0.04100	Invert Level (m)	55.650	Surround Shape	(Trench)
Safety Factor	1.5	Time to half empty (mins)	393	Diameter (mm)	600

Node S29 Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.04100	Invert Level (m)	55.735	Depth (m)	
Side Inf Coefficient (m/hr)	0.04100	Time to half empty (mins)	574	Inf Depth (m)	0.400
Safety Factor	1.5	Pit Width (m)	4.000	Number Required	1
Porosity	0.95	Pit Length (m)	25.000		

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.86%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute summer	J1	18	65.781	0.051	12.2	0.0294	0.0000	OK
30 minute summer	1.000:50%	18	64.143	0.073	24.4	0.4961	0.0000	OK
30 minute summer	S19	18	62.525	0.115	24.4	0.6135	0.0000	OK
30 minute summer	S20	18	62.386	0.076	29.1	0.5541	0.0000	OK
30 minute summer	1.002:50%	18	61.272	0.082	34.0	0.4184	0.0000	OK
30 minute summer	S21	18	60.197	0.127	36.0	0.5429	0.0000	OK
30 minute summer	S22	19	59.691	0.101	45.2	1.7248	0.0000	OK
30 minute summer	S23	19	57.095	0.175	44.5	0.7675	0.0000	OK
30 minute summer	S24	19	56.969	0.149	53.0	0.6971	0.0000	OK
30 minute summer	J2	18	65.459	0.049	10.0	0.0235	0.0000	OK
30 minute summer	S25	18	63.449	0.039	9.9	0.5658	0.0000	OK
30 minute summer	S26	18	61.492	0.082	26.9	0.3693	0.0000	OK
30 minute summer	2.002:50%	18	59.008	0.123	55.2	0.7776	0.0000	OK
30 minute summer	S27	20	56.792	0.432	54.9	2.0151	0.0000	FLOOD RISK
30 minute summer	S28	21	56.607	0.547	94.6	6.2123	0.0000	FLOOD RISK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
30 minute summer	J1	1.000	1.000:50%	12.2	1.377	0.114	0.3523
30 minute summer	J1	1.000	S19	24.4	1.568	0.228	0.6198
30 minute summer	S19	1.001	S20	24.1	1.269	0.433	0.1659
30 minute summer	S19	Infiltration		0.3			
30 minute summer	S20	1.002	1.002:50%	29.0	2.337	0.244	0.2688
30 minute summer	S20	Infiltration		0.1			
30 minute summer	S20	1.002	S21	33.9	1.883	0.285	0.3916
30 minute summer	S21	1.003	S22	35.3	1.578	0.572	0.7655
30 minute summer	S21	Infiltration		0.2			
30 minute summer	S22	1.004	S23	44.5	1.763	0.417	1.6121
30 minute summer	S22	Infiltration		0.3			
30 minute summer	S23	1.005	S24	44.5	1.448	0.801	0.2682
30 minute summer	S23	Infiltration		0.2			
30 minute summer	S24	1.006	S28	52.5	1.414	0.644	1.0548
30 minute summer	S24	Infiltration		0.1			
30 minute summer	J2	2.000	S25	9.9	1.552	0.105	0.3916
30 minute summer	S25	2.001	S26	9.7	1.136	0.067	0.2280
30 minute summer	S25	Infiltration		0.2			
30 minute summer	S26	2.002	2.002:50%	26.6	1.520	0.284	1.3723
30 minute summer	S26	Infiltration		0.1			
30 minute summer	S26	2.002	S27	54.9	1.957	0.585	2.4181
30 minute summer	S27	2.003	S28	42.8	1.214	0.708	0.8828
30 minute summer	S27	Infiltration		0.6			
30 minute summer	S28	2.004	S29	87.5	2.199	1.655	0.5966
30 minute summer	S28	Infiltration		0.4			
30 minute summer	S28	Infiltration		0.4			

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.86%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute winter	S29	180	56.584	0.679	26.2	80.6642	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
180 minute winter	S29	Infiltration		0.9			

Design Settings

Rainfall Methodology	FSR
Return Period (years)	1
Additional Flow (%)	0
FSR Region	England and Wales
M5-60 (mm)	26.250
Ratio-R	0.400
CV	0.750
Time of Entry (mins)	5.00
Maximum Time of Concentration (mins)	30.00
Maximum Rainfall (mm/hr)	50.0
Minimum Velocity (m/s)	1.00
Connection Type	Level Soffits
Minimum Backdrop Height (m)	0.200
Preferred Cover Depth (m)	1.200
Include Intermediate Ground	✓
Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
S30	0.041	5.00	83.190	600	0.590
S31	0.041	5.00	81.660	600	0.640
S32	0.041	5.00	80.230	600	0.590
S33	0.041	5.00	79.530	600	0.590
S34			76.700	600	0.690
S35			76.500	600	0.551
S36			76.300		0.815

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	S30	S31	43.000	0.600	82.600	81.070	1.530	28.1	225	5.29	50.0
1.001	S31	S32	43.000	0.600	81.020	79.640	1.380	31.2	225	5.59	50.0
1.002	S32	S33	43.000	0.600	79.640	78.940	0.700	61.4	225	6.02	50.0
1.003	S33	S34	52.500	0.600	78.940	76.010	2.930	17.9	225	6.30	50.0
1.004	S34	S35	10.258	0.600	76.010	75.949	0.061	168.2	225	6.47	50.0
1.005	S35	S36	7.240	0.600	75.949	75.485	0.464	15.6	225	6.51	50.0

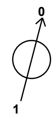
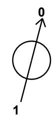
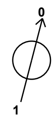
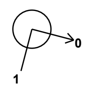
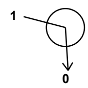
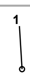
Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	2.477	98.5	5.6	0.365	0.365	0.041	0.0	36	1.360
1.001	2.352	93.5	11.1	0.415	0.365	0.082	0.0	52	1.597
1.002	1.671	66.5	16.7	0.365	0.365	0.123	0.0	77	1.399
1.003	3.106	123.5	22.2	0.365	0.465	0.164	0.0	65	2.373
1.004	1.005	40.0	22.2	0.465	0.326	0.164	0.0	120	1.031
1.005	3.329	132.4	22.2	0.326	0.590	0.164	0.0	62	2.487

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	43.000	28.1	225	Circular	83.190	82.600	0.365	81.660	81.070	0.365
1.001	43.000	31.2	225	Circular	81.660	81.020	0.415	80.230	79.640	0.365
1.002	43.000	61.4	225	Circular	80.230	79.640	0.365	79.530	78.940	0.365
1.003	52.500	17.9	225	Circular	79.530	78.940	0.365	76.700	76.010	0.465
1.004	10.258	168.2	225	Circular	76.700	76.010	0.465	76.500	75.949	0.326
1.005	7.240	15.6	225	Circular	76.500	75.949	0.326	76.300	75.485	0.590

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	S30	600	Manhole	Adoptable	S31	600	Manhole	Adoptable
1.001	S31	600	Manhole	Adoptable	S32	600	Manhole	Adoptable
1.002	S32	600	Manhole	Adoptable	S33	600	Manhole	Adoptable
1.003	S33	600	Manhole	Adoptable	S34	600	Manhole	Adoptable
1.004	S34	600	Manhole	Adoptable	S35	600	Manhole	Adoptable
1.005	S35	600	Manhole	Adoptable	S36		Junction	

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
S30	608756.898	156345.043	83.190	0.590	600		0	1.000	82.600	225
S31	608767.782	156386.643	81.660	0.640	600		1	1.000	81.070	225
							0	1.001	81.020	225
S32	608778.666	156428.243	80.230	0.590	600		1	1.001	79.640	225
							0	1.002	79.640	225
S33	608789.549	156469.843	79.530	0.590	600		1	1.002	78.940	225
							0	1.003	78.940	225
S34	608802.837	156520.634	76.700	0.690	600		1	1.003	76.010	225
							0	1.004	76.010	225
S35	608812.761	156518.038	76.500	0.551	600		1	1.004	75.949	225
							0	1.005	75.949	225
S36	608813.210	156510.812	76.300	0.815			1	1.005	75.485	225

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Detailed
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	26.250	Drain Down Time (mins)	240
Ratio-R	0.400	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	40	0	0

Node S31 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.04100	Porosity	0.30	Link	1.000
Side Inf Coefficient (m/hr)	0.04100	Invert Level (m)	80.660	Surround Shape	(Trench)
Safety Factor	1.5	Time to half empty (mins)	9	Diameter (mm)	600

Node S32 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.04100	Porosity	0.30	Link	1.001
Side Inf Coefficient (m/hr)	0.04100	Invert Level (m)	79.230	Surround Shape	(Trench)
Safety Factor	1.5	Time to half empty (mins)	32	Diameter (mm)	600

Node S33 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.04100	Porosity	0.30	Link	1.002
Side Inf Coefficient (m/hr)	0.04100	Invert Level (m)	78.530	Surround Shape	(Trench)
Safety Factor	1.5	Time to half empty (mins)	68	Diameter (mm)	600

Node S34 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.04100	Porosity	0.30	Link	1.003
Side Inf Coefficient (m/hr)	0.04100	Invert Level (m)	75.700	Surround Shape	(Trench)
Safety Factor	1.5	Time to half empty (mins)	4	Diameter (mm)	600

Node S36 Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.04100	Invert Level (m)	75.485	Depth (m)	
Side Inf Coefficient (m/hr)	0.04100	Time to half empty (mins)	495	Inf Depth (m)	0.400
Safety Factor	1.5	Pit Width (m)	10.000	Number Required	1
Porosity	0.95	Pit Length (m)	15.000		

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.32%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute summer	S30	18	82.686	0.086	29.4	0.1439	0.0000	OK
30 minute summer	S31	18	81.148	0.128	58.8	0.8002	0.0000	OK
30 minute summer	S32	19	80.146	0.506	88.0	3.1034	0.0000	FLOOD RISK
30 minute summer	S33	19	79.099	0.159	102.1	2.0115	0.0000	OK
30 minute summer	S34	20	76.699	0.689	101.5	1.7317	0.0000	FLOOD RISK
360 minute winter	S35	352	76.267	0.318	16.9	0.0900	0.0000	FLOOD RISK
360 minute winter	S36	352	76.267	0.782	16.9	111.4459	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
30 minute summer	S30	1.000	S31	29.4	2.146	0.298	0.5891
30 minute summer	S31	1.001	S32	58.6	1.692	0.627	1.3573
30 minute summer	S31	Infiltration		0.2			
30 minute summer	S32	1.002	S33	75.4	1.897	1.135	1.6900
30 minute summer	S32	Infiltration		0.3			
30 minute summer	S33	1.003	S34	101.5	2.687	0.822	1.8305
30 minute summer	S33	Infiltration		0.3			
30 minute summer	S34	1.004	S35	99.1	2.583	2.479	0.3716
30 minute summer	S34	Infiltration		0.2			
360 minute winter	S35	1.005	S36	16.9	2.218	0.127	0.2879
360 minute winter	S36	Infiltration		1.3			

Design Settings

Rainfall Methodology	FSR
Return Period (years)	1
Additional Flow (%)	0
FSR Region	England and Wales
M5-60 (mm)	26.250
Ratio-R	0.400
CV	0.750
Time of Entry (mins)	5.00

Maximum Time of Concentration (mins)	30.00
Maximum Rainfall (mm/hr)	50.0
Minimum Velocity (m/s)	1.00
Connection Type	Level Soffits
Minimum Backdrop Height (m)	0.200
Preferred Cover Depth (m)	1.200
Include Intermediate Ground	✓
Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
S37	0.074	5.00	75.500	600	0.590
S38			64.500	600	0.590
S39			63.000		0.745

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	S37	S38	173.711	0.600	74.910	63.910	11.000	15.8	225	5.87	50.0
1.001	S38	S39	9.999	0.600	63.910	62.255	1.655	6.0	225	5.91	50.0

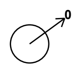
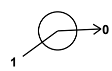
Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	3.309	131.6	10.0	0.365	0.365	0.074	0.0	42	1.972
1.001	5.358	213.0	10.0	0.365	0.520	0.074	0.0	33	2.772

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	173.711	15.8	225	Circular	75.500	74.910	0.365	64.500	63.910	0.365
1.001	9.999	6.0	225	Circular	64.500	63.910	0.365	63.000	62.255	0.520

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	S37	600	Manhole	Adoptable	S38	600	Manhole	Adoptable
1.001	S38	600	Manhole	Adoptable	S39		Junction	

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
S37	608640.552	155691.049	75.500	0.590	600		0	1.000	74.910	225
S38	608780.595	155793.828	64.500	0.590	600		1	1.000	63.910	225
							0	1.001	63.910	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S39	608790.584	155794.280	63.000	0.745		1	1.001	62.255	225

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Detailed
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	26.250	Drain Down Time (mins)	240
Ratio-R	0.400	Additional Storage (m^3/ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	40	0	0

Node S39 Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.04100	Invert Level (m)	62.085	Depth (m)	
Side Inf Coefficient (m/hr)	0.04100	Time to half empty (mins)	560	Inf Depth (m)	0.400
Safety Factor	1.5	Pit Width (m)	8.000	Number Required	1
Porosity	0.95	Pit Length (m)	9.000		

Node S38 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.04100	Porosity	0.30	Link	1.000
Side Inf Coefficient (m/hr)	0.04100	Invert Level (m)	63.500	Surround Shape	(Trench)
Safety Factor	1.5	Time to half empty (mins)	0	Diameter (mm)	600

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.73%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute summer	S37	18	75.009	0.099	53.0	0.2752	0.0000	OK
30 minute summer	S38	18	63.989	0.079	51.9	0.3598	0.0000	OK
480 minute winter	S39	472	62.876	0.621	6.2	54.1303	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
30 minute summer	S37	1.000	S38	51.9	3.123	0.395	2.8874
30 minute summer	S38	1.001	S39	51.7	4.318	0.243	0.2228
30 minute summer	S38	Infiltration		0.1			
480 minute winter	S39	Infiltration		0.6			

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	1	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	26.250	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
S40	0.074	5.00	71.300	600	0.590
S41			63.000	600	0.590
S42			62.000		0.745

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	S40	S41	173.710	0.600	70.710	62.410	8.300	20.9	225	6.01	50.0
1.001	S41	S42	9.999	0.600	62.410	61.255	1.155	8.7	225	6.05	50.0

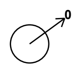
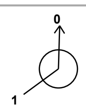
Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	2.872	114.2	10.0	0.365	0.365	0.074	0.0	44	1.775
1.001	4.473	177.9	10.0	0.365	0.520	0.074	0.0	36	2.425

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	173.710	20.9	225	Circular	71.300	70.710	0.365	63.000	62.410	0.365
1.001	9.999	8.7	225	Circular	63.000	62.410	0.365	62.000	61.255	0.520

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	S40	600	Manhole	Adoptable	S41	600	Manhole	Adoptable
1.001	S41	600	Manhole	Adoptable	S42		Junction	

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
S40	608736.999	155563.101	71.300	0.590	600		0	1.000	70.710	225
S41	608877.041	155665.880	63.000	0.590	600		1	1.000	62.410	225
							0	1.001	62.410	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S42	608877.334	155675.875	62.000	0.745		1	1.001	61.255	225

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Detailed
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	26.250	Drain Down Time (mins)	240
Ratio-R	0.400	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	40	0	0

Node S42 Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.04100	Invert Level (m)	61.085	Depth (m)	
Side Inf Coefficient (m/hr)	0.04100	Time to half empty (mins)	560	Inf Depth (m)	0.400
Safety Factor	1.5	Pit Width (m)	8.000	Number Required	1
Porosity	0.95	Pit Length (m)	9.000		

Node S41 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.04100	Porosity	0.30	Link	1.000
Side Inf Coefficient (m/hr)	0.04100	Invert Level (m)	62.000	Surround Shape	(Trench)
Safety Factor	1.5	Time to half empty (mins)	0	Diameter (mm)	600

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.76%

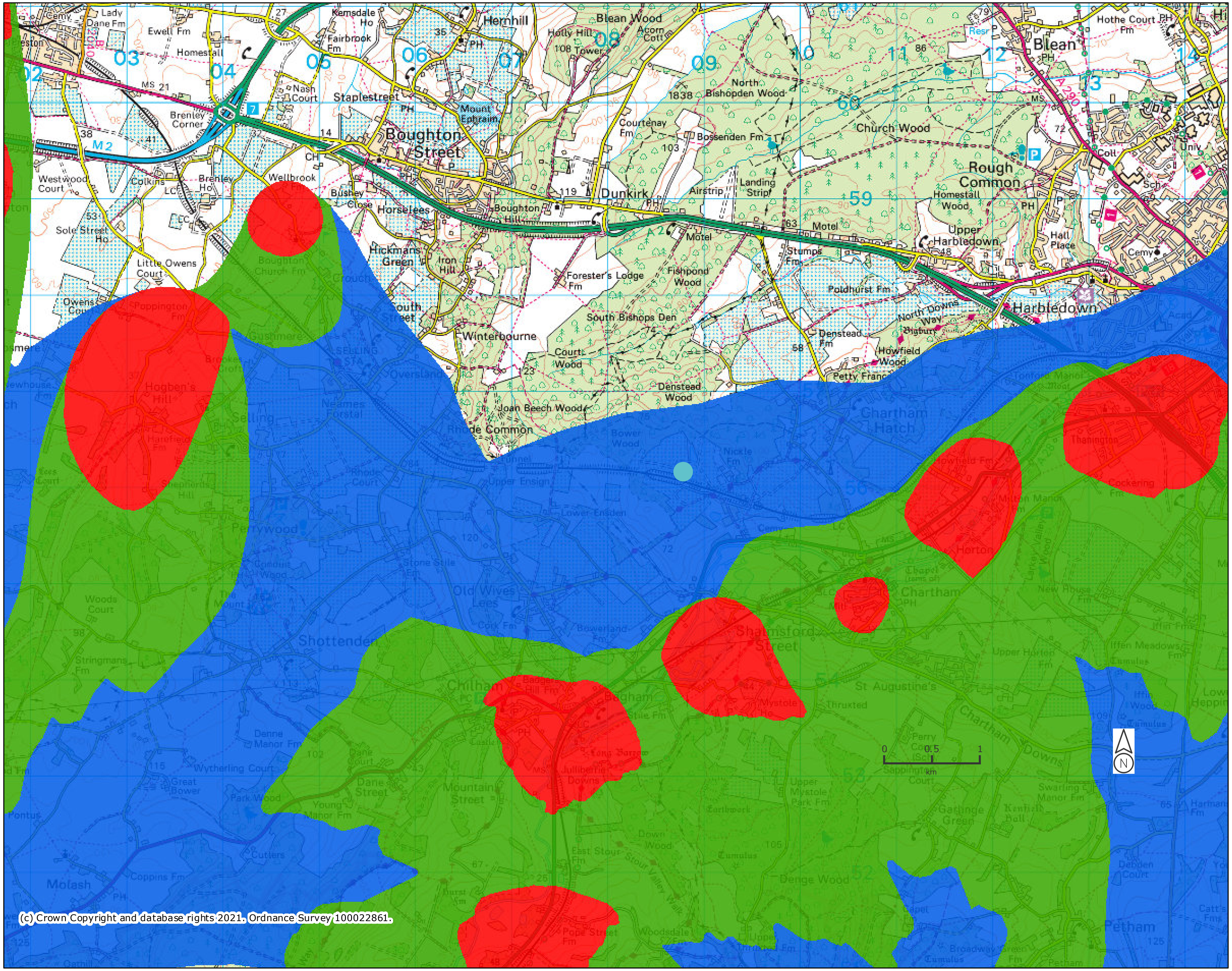
Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute summer	S40	18	70.816	0.106	53.0	0.2972	0.0000	OK
30 minute summer	S41	18	62.497	0.087	51.5	0.4856	0.0000	OK
360 minute winter	S42	352	61.868	0.613	7.9	53.5807	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
30 minute summer	S40	1.000	S41	51.5	2.806	0.451	3.1888
30 minute summer	S41	1.001	S42	51.3	3.767	0.288	0.2254
30 minute summer	S41	Infiltration		0.1			
360 minute winter	S42	Infiltration		0.6			

Appendix E – MAGIC Maps

MAGIC

21012 (SPZ)



Legend

Source Protection Zones merged (England)

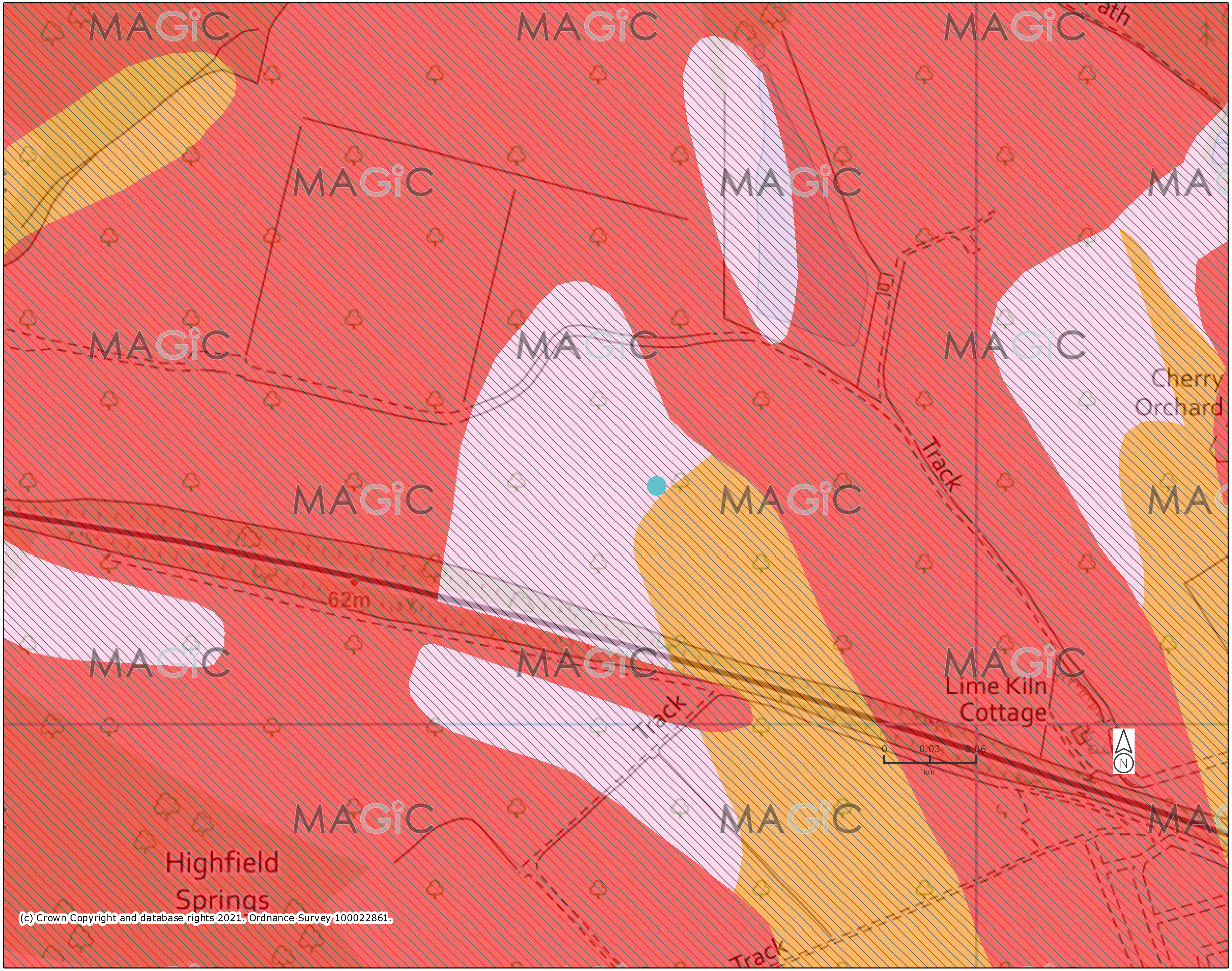
- Zone I - Inner Protection Zone
- Zone I - Subsurface Activity
- Zone II - Outer Protection Zone
- Zone II - Subsurface Activity
- Zone III - Total Catchment
- Zone III - Subsurface Activity
- Zone of Special Interest

Projection = OSGB36
xmin = 598900
ymin = 151500
xmax = 617200
ymax = 160600

Map produced by MAGIC on 10 October, 2021.

MAGIC

21012



Legend

Groundwater Vulnerability Map (England)

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

Projection = OSGB36
xmin = 608200
ymin = 155900
xmax = 609300
ymax = 156400

0 0.045 0.09
km

Map produced by MAGIC on 10 October, 2021.