PROPOSED CONSTRUCTION OF TWO WAREHOUSES AND AN OFFICE BUILDING NEAR MITCHELL, CORNWALL

FLOOD RISK ASSESSMENT

J-1846-Rev.01

Engineering & Development Solutions

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FLOOD RISK ASSESSMENT

Report No.	Issue Detail	Originator	Date	Checked by	Date
J-1846	01	JM	29/03/2021	JC	29/03/2021

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Job No: J-1846
Date: March 2021
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CONTENTS

APPENDICES

1.0 INTRODUCTION

Winfield Holdings S.W Ltd. are proposing to develop land adjacent to the Truro Farm Machinery site in Mitchell to provide two warehouses and an office building.

As shown in **Figures 1** & **2** below, the site is to the north-east of Mitchell and to the north of the A30 road in Cornwall.

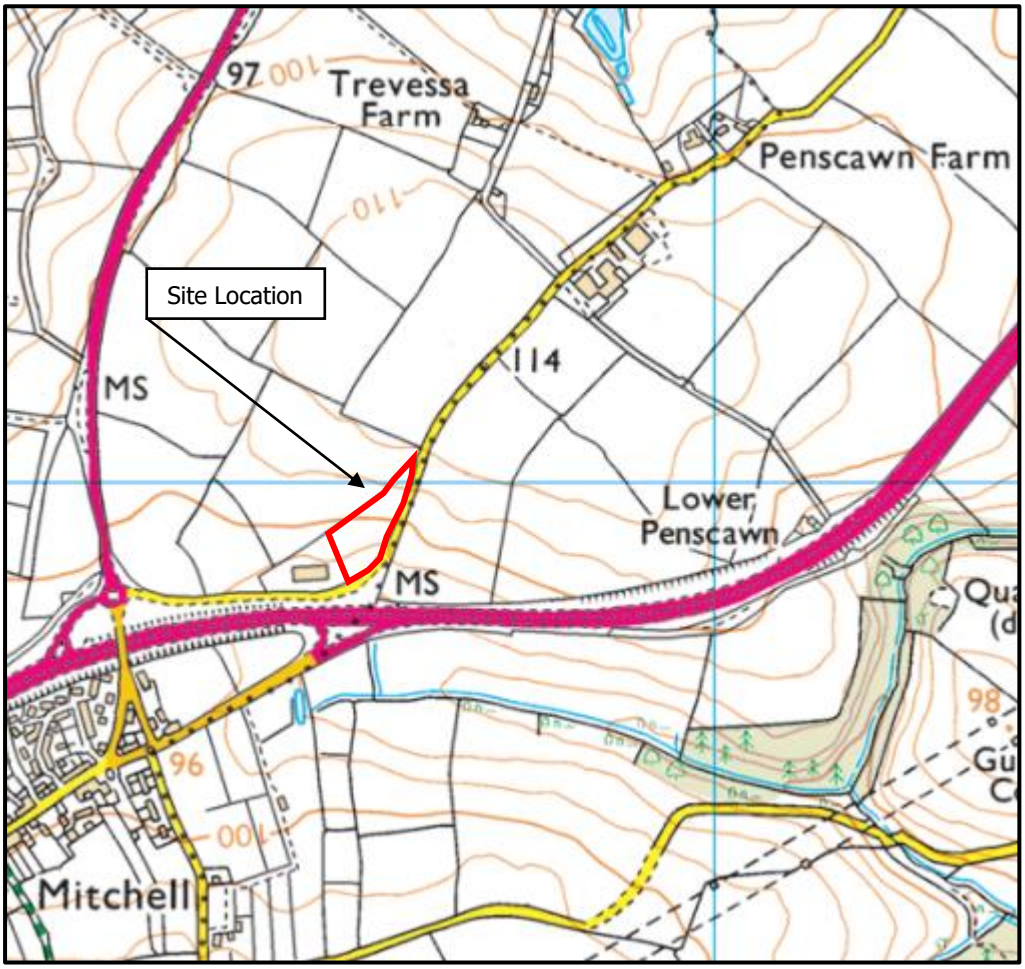

Figure 1 Site Location & Geographical Area

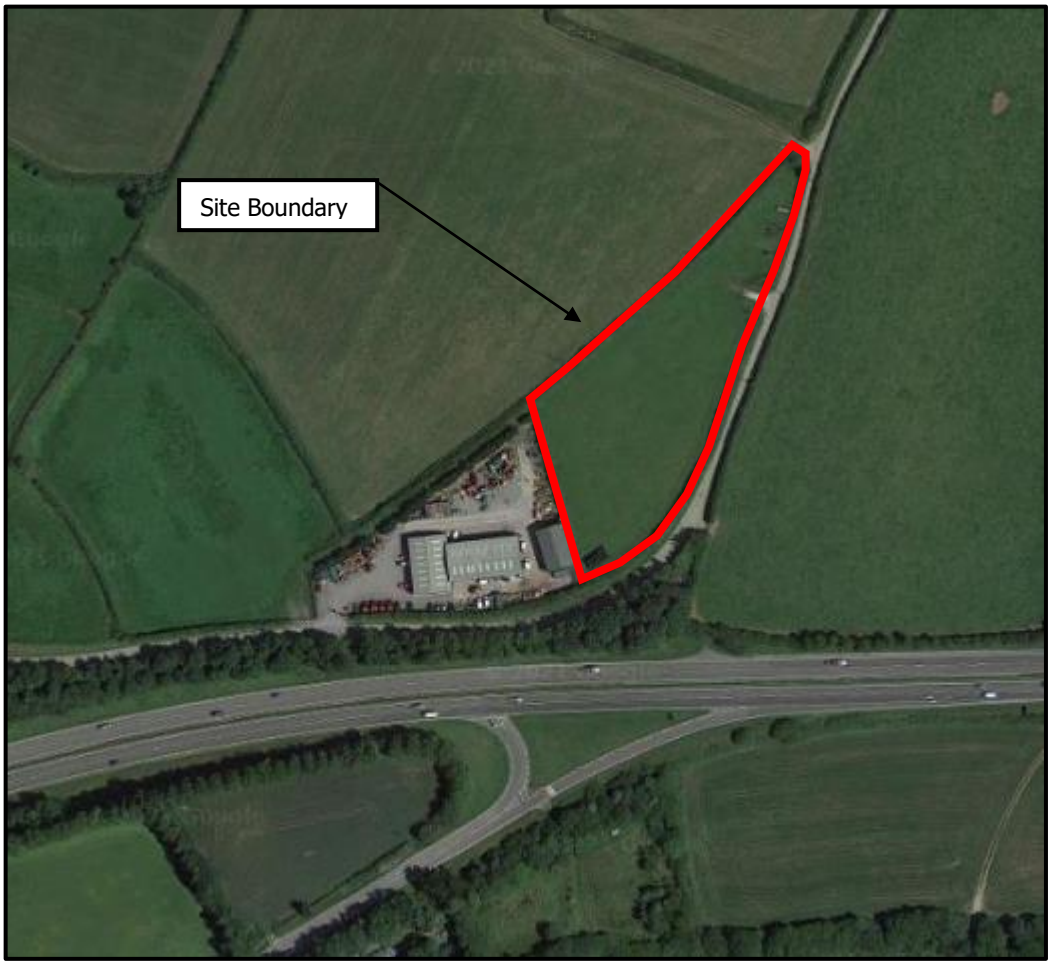

Figure 2 Site Boundary

Site Description

As shown in **Figures 1** & **2**, above, the site is currently undeveloped land and is located approximately 310m to the north-east of the village of Mitchell. The approximate Ordnance Survey Grid Reference for the site is SW 86531 54950.

The site is roughly triangular in form, with an area of approximately 1 hectare, and is currently accessed from an unnamed road on the eastern boundary of the site.

In general terms, the site slopes from high points in the north-eastern corner of the site down to the south-west. The site currently has elevations ranging from 106.88m AOD near the north-eastern corner of the site, 102.22m AOD in site access / egress area on the eastern boundary of the site, and 91m AOD in the southern corner of the site.

The topography of the land surrounding the site falls to the A30 road which is located about 35m to the south of the site. From the site the land rises in a north/north-easterly direction. A local high point of 114m AOD can be found about 170m to the north-east of the site near Penscawn Farm.

As shown in **Figure 2**, above, the character of the land surrounding the site is agricultural with the exception of to the south-west where a farm machinery business is located.

Existing Usage

The site is currently undeveloped agricultural land.

Proposed Usage

As shown in **Appendix A**, it is proposed to construct two warehouses, an office building, access roads and associated parking on site.

Flood Risk Context

The Environment Agency (EA) flood map for planning shows the site is in Flood Zone 1 (less than 1 in 1,000 annual probability of river or sea flooding). However, as the proposed development area is over 1,000m^2 there is a requirement for the application for planning permission to be accompanied by a Flood Risk Assessment (FRA) which is the basis of this report.

The primary aim of this FRA will be to ensure that the proposed development does not increase flood risks down slope of the site. This can be achieved by providing a suitable sustainable drainage scheme (SuDS) that manages surface water runoff from the proposed development.

To address this requirement, Engineering & Development Solutions (EDS) have been commissioned to prepare an FRA including a surface water drainage strategy for the proposed development, in accordance with the best practice principles of SuDS, the National Planning Policy Framework (NPPF), Drainage Guidance for Cornwall (DGfC) and Planning Practice Guidance (PPG). This report details the findings of the study.

2.0 ASSESSMENT OF FLOOD RISKS

Groundwater

Groundwater flooding is linked to the ability of the ground to hold water. The Cornwall Council Strategic Flood Risk Assessment (SFRA) highlights that the geology of Cornwall has only minor aquifers and generally does not experience much groundwater flooding.

In addition, trial pits were opened on site for percolation testing to a maximum depth of 2.2m which showed no evidence of any groundwater. As such, the risk of groundwater flooding on site is not considered any further in this report.

Overland Flow

As described above, the proposed development site is situated on land that slopes from high points in the north-eastern corner of the site down to lower ground in the south/south-western area of the site. Higher ground to the north/north-east of the site is largely composed of agricultural undeveloped land.

It is therefore anticipated that any overland flows generated up slope of the site would be intercepted by hedgerows and natural drainage systems, evaporate, or percolate into the ground before reaching the site.

The Environment Agency (EA) surface flood map extract for the site area, **Figure 3** below, shows the risk of surface water flooding on site. It indicates that the risk of surface water flooding on site is very low.

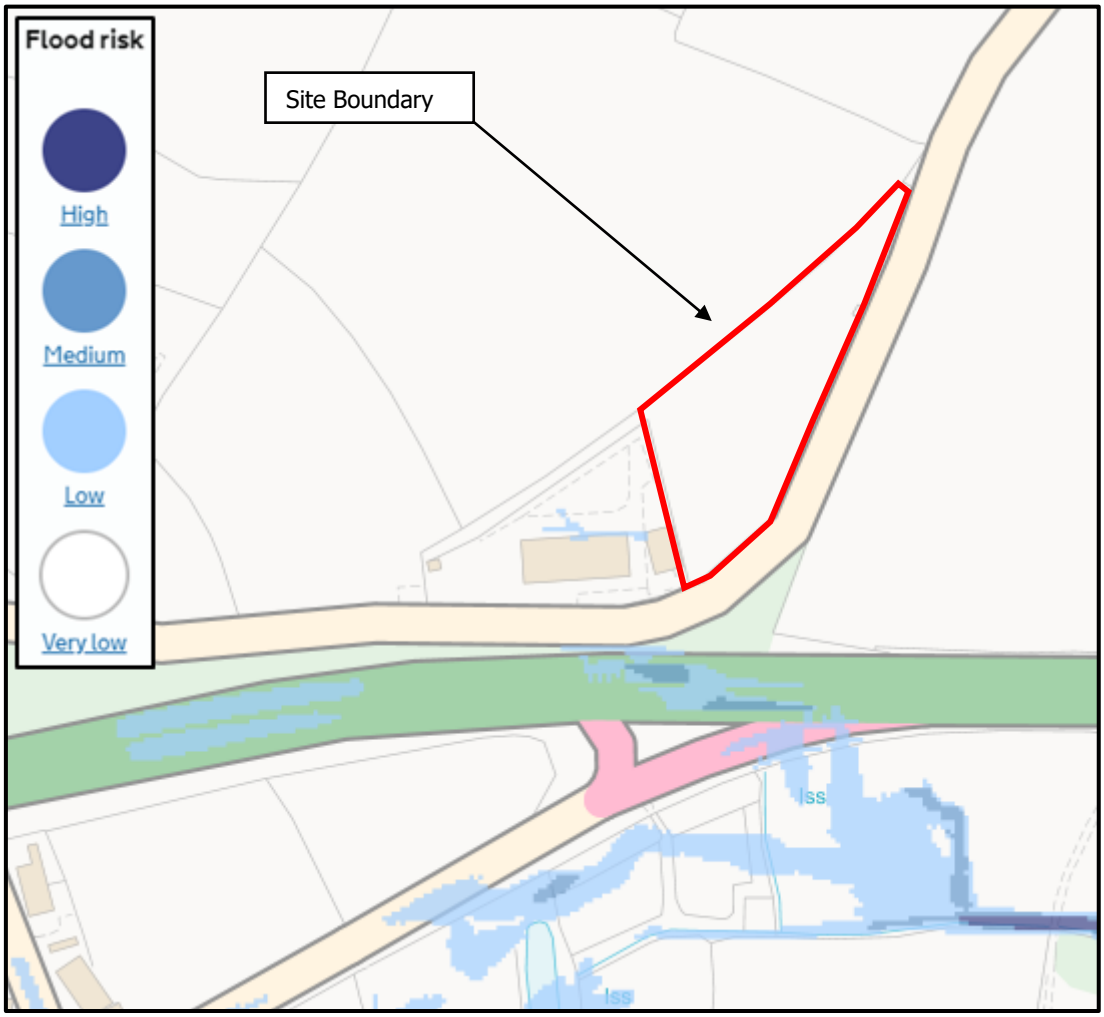

Figure 3 EA Flood Risk from Surface Water Map Extract

Fluvial and Tidal Flood Risk

The Environment Agency indicative flood map, **Figure 4**, below, shows that the site is in Flood Zone 1 (less than 1 in 1,000 annual probability of river or sea flooding).

The nearest watercourse to the site is the source of an unnamed tributary of the Upper Tresillian River, which is located about 160m to the south of the site. The nearest area of tidal influence is Perranporth beach which is about 10km to the west of the site.

The site is therefore deemed to be not at risk from either fluvial or tidal flooding, so these mechanisms of flooding are not considered further in this report.

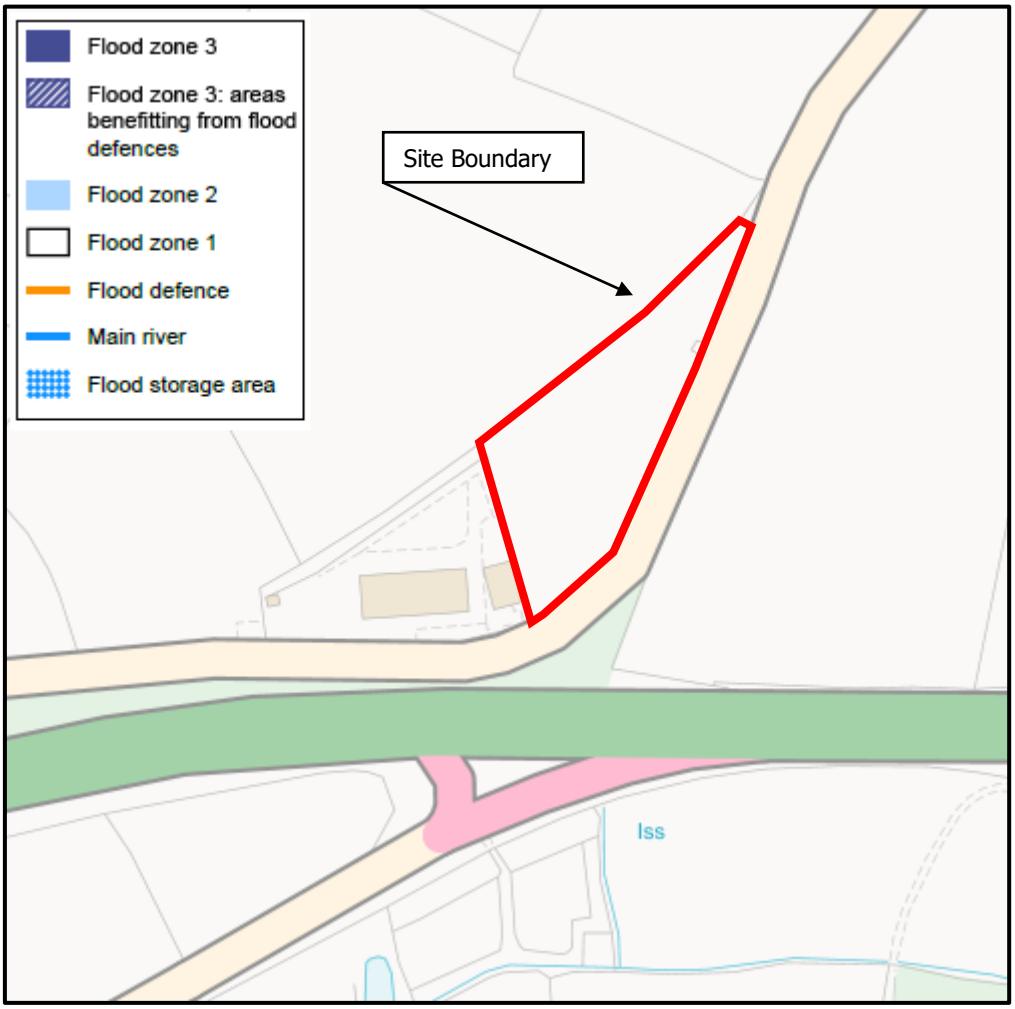

Figure 4 Environment Agency Flood Map for Planning (Rivers & Sea) Extract

Flood Summary

From the information provided above, the proposed development site has been shown to be located in Flood Zone 1, and at very low risk of surface water flooding.

Flooding as a Result of Development

Development of the site will alter the nature of surface permeability throughout the site. The proposed development will create impermeable areas through the implementation of industrial units, an office unit, and paved areas where there are currently greenfield permeable areas. Thus, the rate at which surface water runs off these areas could increase post development.

Consequently, it is important that surface water runoff from the proposed development is understood and managed to prevent an increase in flood risks to third parties and interests down slope of the site post development.

By designing the site's surface water drainage infrastructure in accordance with the advice reproduced in **Section 3** of this report, the proposed development will not increase flood risks to third parties and interests downslope of the site.

In consideration of the information presented above, the sustainable surface water drainage system that is proposed for the proposed development is described in more detail in **Section 5** of this report.

3.0 DESIGN STANDARDS

Design of the site drainage infrastructure and Sustainable Drainage System (SuDS) is to be carried out in line with best practice, and to industry standard design procedures. Several publications, including design guidance and best practice guidance will be applied to different components of the final SuDS infrastructure. The sections below provide an overview of the design standards to be used on this project for various aspects of the SuDS infrastructure design.

The CIRIA SuDS Manual (C753)

This document is a comprehensive publication covering design, construction, operation and maintenance of SuDS. The advice and best practice outlined in this document has been utilised in the design of the site SuDS features which have been detailed in this report.

Building Regulations Part H

Building Regulations Part H 'Drainage and Waste Disposal' covers the design and installation of surface water and foul water systems. All private drainage including pipes, manholes, down pipes, and other drainage infrastructure on the site should be designed and installed in accordance with this document.

The Wallingford Procedure

Developed by HR Wallingford, this publication covers the design of urban drainage systems. In addition, the document includes regional rainfall data for use in design for varying return period events. Basic sizing calculations for the proposed SuDS system and the estimation of the runoff volumes have been made using this method.

National Planning Policy Framework

The National Planning Policy Framework (NPPF) contains the policy relating to the appropriate assessment of flood risk within the UK. The associated technical guidance provides further details on the definitions, classifications and constraints used to apply national policy to new developments.

It contains details on flood zone definition, site specific FRA's, vulnerability classifications, appropriate development, climate change allowances, residual risk management, flood resilience, the sequential test and the exception test.

Drainage Guidance for Cornwall

This document provides advice for Cornwall Council as the Local Planning Authority and those involved in developing the built environment on:

- The location of Critical Drainage Areas, where flood risks from surface water runoff are likely to be most significant
- Standards to be achieved by surface water drainage
- The content of a FRA considering surface water drainage
- Sustainable Drainage techniques (SuDs)
- Sources of further information

The Drainage Guidance for Cornwall (DGfC) document is currently under review. However, until an updated version is published, advice appropriate to the proposed development considered within this report is reproduced below for ease of reference.

The development site is not within a Critical Drainage Area but has an approximate area of 1 hectare. It is therefore considered that the following DGfC guidance is appropriate with respect to the development proposals:

Outside Critical Drainage Areas

E4 -Developments greater than or equal to 1 hectare Greenfield Sites

- *Following the Building Regulations Drainage hierarchy, surface water should:-*

i. *Drain to a soakaway or infiltration system designed in accordance with the SUDS Manual - CIRIA C697, using a minimum of a 30-year return period storm.*

Where an FRA demonstrates that infiltration is not possible:-

ii. *A sustainable drainage system shall be provided ensuring flow attenuation, no adverse impact on water quality and where possible habitat creation.*

- *The total discharge from the site should aim to mimic greenfield rates. These shall be no more than the theoretical greenfield run-off rates from each of the corresponding 1, 10, 30 and 100 year storms. When these values are less than 5 litres/second, a rate of 5 litres/second can be used. Attenuation may not be necessary if the discharge is directly to coastal waters. In these cases, the impact on the receiving environment in terms of habitat, erosion and water quality should be assessed.*

- *The design must take into account the appropriate allowance for increased rainfall from climate change. This should be based on the lifetime of the development, the guidance in Annex B of PPS25 and the PPS25 Practice Guide.*

- *Underground attenuation and piped sections should be designed for a minimum of the 30-year storm. However total discharge rates from the site must still be controlled for the 100-year storm. Attenuation of events exceeding the piped system may be achieved by temporary flooding of open spaces or car parks. If surface flooding of open areas is not appropriate, the formal drainage system should be designed for the 100 year storm.*

- *Where infiltration is not used, long-term storage must be provided to store the additional volume of run-off caused by any increase in impermeable area. This is in addition to the attenuation storage required to address flow rates, see Appendix F. Alternatively rainwater harvesting can be used to offset this volume.*

- *The long-term storage should discharge at a rate not exceeding 2 litres/second/hectare, as per Preliminary rainfall run-off management for developments DEFRA /Environment Agency guidance W5-074 Revision D.*

- *Safe and appropriate flow routes from blockage and exceedance of the drainage system must be evaluated. This must demonstrate no property flooding or increase in flood risk, either offsite or to third parties.*

4.0 POLICY

The proposed development has been shown to be located within Flood Zone 1. In accordance with PPG Table 2, a development of this type, '*Buildings used for general industry*', is classified as 'Less Vulnerable'.

Referring to Table 3 of PPG (**Figure 5**, below), a 'Less Vulnerable' development within Flood Zone 1 is appropriate.

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

Key:

✓ Development is appropriate

✗ Development should not be permitted.

Figure 5 PPG Table 3

5.0 PROPOSED SUSTAINABLE DRAINAGE SYSTEM (SUDS)

The preferable surface water drainage solution for the site would be to drain all surface water runoff from the proposed development using infiltration as close to source as possible.

Site investigation work was undertaken by Engineering and Development Solutions in line with BRE 365/CIRIA 156 on 17/02/2021. Percolation tests were carried out in three trial pits across the site; the results of which are included in **Appendix B** and summarised in **Table 1**, below. The trial pits showed moderate to rapid rates of infiltration that are suitable for soakaway design / use.

Trial Pit	Infiltration Rate (m/s)	Infiltration Rate (m/hr)
TP1	7.19E-05	0.259
TP2	1.45E-03	5.217
TP3	2.73E-04	0.982

Table 1 Percolation Test Results

The infiltration rate used for each soakaway in the proposed SuDS scheme has been calculated using the infiltration rate observed in the percolation test pit nearest to each proposed soakaway.

Drainage Design – Infiltration System

As per the guidance outlined in **Section 3** above, the preferred surface water drainage solution for the proposed development would be to drain all surface water runoff to ground soakaways designed to a minimum 30 year return period storm.

In this case, a 100 year return period has been used with a 40% climate change allowance, based on experience of Cornwall Council requirements for other similar development proposals.

Warehouses

As shown on Drawing 3001A in **Appendix A**, it is proposed that each warehouse has its own dedicated soakaway system to deal with surface water runoff originating from the roof.

Warehouse Access Roads / Parking Areas

As shown on Drawing 3001A in **Appendix A**, it is proposed that the access road and parking areas for each warehouse will have a dedicated soakaway system to deal with surface water runoff originating from the access road and parking area for each warehouse.

Office Building and Associated Access Road / Parking Area

In reference to Drawing 3001A in **Appendix A**, it is proposed that the office building and associated access road / parking area will have a dedicated soakaway to deal with surface water runoff originating from the office building roof, access road and parking area.

The soakaways shown on Drawing 3001A in **Appendix A** have been sized in accordance with CIRIA 156 guidance to serve the warehouses, office building, parking areas, and access road impermeable areas, and assumes use of modular infiltration units (e.g., Stormbloc).

A system of downpipes and gullies would convey surface water from the impermeable areas into the soakaway system.

The proposed surface water drainage layout (Drawing 3001A) included in **Appendix A** shows the indicative layout of the conceptual infiltration based soakaway system for the proposed development. Calculations for the proposed soakaway system are presented in **Appendix B**.

Exceedance Events

In the unlikely event that a storm in excess of the 1 in 100 year return period including climate change rainfall event were to occur, or if the proposed surface water drainage system were to become blocked, surface water runoff from the proposed development may surcharge the soakaway system.

Based on existing and surrounding site levels, it is anticipated that if surcharging of the soakaway system occurred, surface water exceedance flows would flow over the site in a manner consistent with the pre-development scenario. As shown in **Appendix A**, this would be across the site from higher ground in the north-eastern area of the site down to lower ground to the south / south-west of the site.

Due to the storage provided in the proposed infiltration system, and design standard used (1 in 100 year storm with an additional 40% allowance for the effects of climate change), any exceedance flows would be lower than would flow off the site in the pre-development scenario for a similar storm event.

Management and Maintenance

The site will remain in private ownership so management and maintenance responsibilities for the proposed surface water soakaway system will fall to the site owner.

Maintenance activities will broadly comprise regular and occasional tasks, as per the guidance outlined in **Table 2**, below.

SOAKAWAYS		
Regular maintenance	Inspect for sediment and debris in upstream silt traps and floor of inspection tube or chamber	Annually
	Cleaning of gutters and any filters on downpipes	Annually (or as required based on inspections)
	Trimming any roots that may be causing blockages	Annually (or as required)
Occasional maintenance	Remove sediment and debris from upstream silt traps and floor of inspection tube or chamber	As required, based on inspections
Remedial actions	Reconstruct soakaway and/or replace or clean units if performance deteriorates or failure occurs	As required
	Replacement of clogged geotextile (will required reconstruction of soakaway)	As required
Monitoring	Inspect silt traps and note rate of sediment accumulation	Monthly in the first year then annually

	Check soakaway to ensure emptying is occurring	Annually

Table 2 Recommended Soakaway Maintenance Tasks

Residual Risks After Development

Rainfall over and above the design event could cause the surface water sustainable drainage system serving the proposed development to surcharge. However, any exceedance flows would be dealt with as outlined above.

The surface water SuDS proposed in this report has been designed for the volume of surface runoff resulting from the proposed development. Thus, any unauthorised future connections into the on site soakaway network could potentially overload the system. Any future development on site, beyond the current proposal, should be suitably planned and considered.

6.0 SUMMARY AND CONCLUSIONS

This study has investigated mechanisms of flooding on site, and the potential for a surface water Sustainable Drainage System (SuDS) to serve a proposed development on land owned by Truro Timber near Mitchell in Cornwall.

Environment Agency (EA) indicative flood mapping shows that the proposed development site is located entirely within Flood Zone 1 (at little or no risk from tidal or fluvial flooding) and is therefore suitable for all types of development.

The proposed development covers an area in excess of 1,000m^2, therefore detailed consideration of surface water drainage for the proposed development has been undertaken.

This study has concluded that the site is not at risk of flooding from the mechanisms of flooding considered in this report. Furthermore, flood risks down slope of the site will not increase post development once the Sustainable Drainage System (SuDS) outlined in this report, and shown in **Appendix A**, is operational.

On site percolation testing has demonstrated that the site is suitable for the use of an infiltration based surface water SuDS. Therefore, a soakaway-based surface water SuDS has been designed to a 100 year standard, with a 40% allowance for climate change for the proposed development.

The use of an infiltration based SuDS for the proposed development is predicted to reduce the level of surface water runoff from the site when compared to the pre-development scenario.

Management and maintenance responsibility for the proposed surface water SuDS will fall to the site owner; maintenance recommendations for the proposed surface water SuDS have been outlined in this report.

Provided the recommendations detailed in this report are incorporated into the development proposals there is the capacity to manage surface water runoff from the proposed development on site.

The proposed surface water drainage infrastructure has been designed in accordance with guidance outlined in the NPPF, Drainage Guidance for Cornwall, PPG, and additional guidance from Cornwall Council. Therefore, the proposed development is entirely appropriate on this site from a flood risk perspective.

APPENDIX A TOPOGRAPHIC SURVEY & PROPOSED SITE SUDS PLAN

KEY

- PROPOSED PRIVATE SURFACE WATER DRAINAGE
- PROPOSED PRIVATE SURFACE WATER POLYPROPYLENE INSPECTION CHAMBER (475Ø/450Ø P.P.I.C.)
- SW — PROPOSED SURFACE WATER MANHOLE (1200Ø P.C.C.)
- PROPOSED PRIVATE SOAKAWAY CONSTRUCTED USING MODULAR INFILTRATION UNITS
- PERCOLATION TEST LOCATION
- FLOOD EXCEEDANCE ROUTES
- 1B — CNS20s/11 CONDOR FULL RETENTION SEPARATOR
- 2B — CNS30s/11 CONDOR FULL RETENTION SEPARATOR

NOTES

1. This drawing is copyright. Refer to details above.
2. This drawing is only to be used for the purposes described in the status box below.
   Work to figured dimensions only, do not scale.
3. This drawing is to be read in conjunction with all other drawings, details and specifications pertaining to the work described. It should only be used for the purpose marked in the status box below, and shall not be used for construction unless clearly marked CONSTRUCTION.
4. Materials and workmanship shall comply to the appropriate British Standards and Codes of Practice unless otherwise stated.
5. The activities required to construct the work, shown on drawings clearly marked CONSTRUCTION, may be subject to the provisions of the Construction (Design & Management) Regulations 2015. The Contractor and Client must ensure that they are adequately conversant with these regulations and that the appropriate procedures required under the regulations are observed at all times.
6. Design Risk Assessment

   A risk assessment relating to potential hazards associated with the works described within this drawing, in so far as they have been designed by EDS Ltd, has been undertaken. Risks identified have been eliminated by design wherever practicable. The status with regard to residual risks is as follows:

   The work is of low complexity with low level of risk; it is considered that there are no significant residual risks that would not be readily foreseeable by a competent contractor, observing good working practices.

Designer - EDS Drawing revision - A
Date - 25/03/21

DATE.	DRWN.	CHKD.	REV.	NOTES.
25/03/21	JM	BD	A	PRELIMINARY ISSUE

PROJECT MANAGER:-	JAN CLARK
PROJECT ENGINEER:-	JOSHUA MUNYARD
DRAWN DATE:-	MAR 2021
SCALE & SHEET SIZE:-	1:300 @ A1

PRELIMINARY

EDS
Engineering & Development Solutions
- Flood Risk Assessment
- SuDS and Surface Water
- Foul and Sewage Treatment
- Highway Design
- Civil Engineering
- Statutory Approvals

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CLIENT
WINFIELD HOLDINGS S.W LTD.

PROJECT
PROPOSED DEVELOPMENT AT TRURO TIMBER FRAME

DRAWING TITLE
CONCEPTUAL SURFACE WATER DRAINAGE LAYOUT

PROJECT No.	DRAWING No.	REV.
J-1846	3001	A

APPENDIX B CALCULATIONS

Engineering & Development Solutions	Job No.	Job Name	Prepared	Date
Unit 10 Penstraze Business Centre, Truro, Cornwall, TR4 8PN Tel 07973816457	J-1846	Truro Timberframe	EDS	19/02/2020

Pit Dimensions

Depth (m)	Length (m)	Width (m)
2.00	2.00	0.60

Test Date:	17/02/2021
Trial Pit No.:	TP1
Test No.:	1

Soakaway test - tabulated data

Time (hh:mm)	Depth to Water (m)	Elapsed Time (sec)	Water Depth (m)	% Effective	Volume (m^3)
09:15	1.20	0	0.80	100%	0.96
09:18	1.30	180	0.70	88%	0.84
09:21	1.40	360	0.60	75%	0.72
09:35	1.60	1200	0.40	50%	0.48
09:45	1.80	1800	0.20	25%	0.24
09:55	2.00	2400	0.00	0%	0.00

% Effective	Vol (m^3)	T (sec)
88%	0.84	180
75%	0.72	360
75%	0.72	360
50%	0.48	1200
0%	0.00	2400
25%	0.24	1800
75%-25%	0.48	1440

Effective Values Summary

Datum (0,0) is ground level at pit

Initial Depth	1.20	m (below datum)
Final Depth	2.00	m (below datum)
Storage Depth	0.80	m (effective depth)
$a_{p50\%}$	3.28	m^2

$$q = \frac{V_{p75\text{-}25}}{a_{p50} \times t_{p75\text{-}25}}$$

Where:

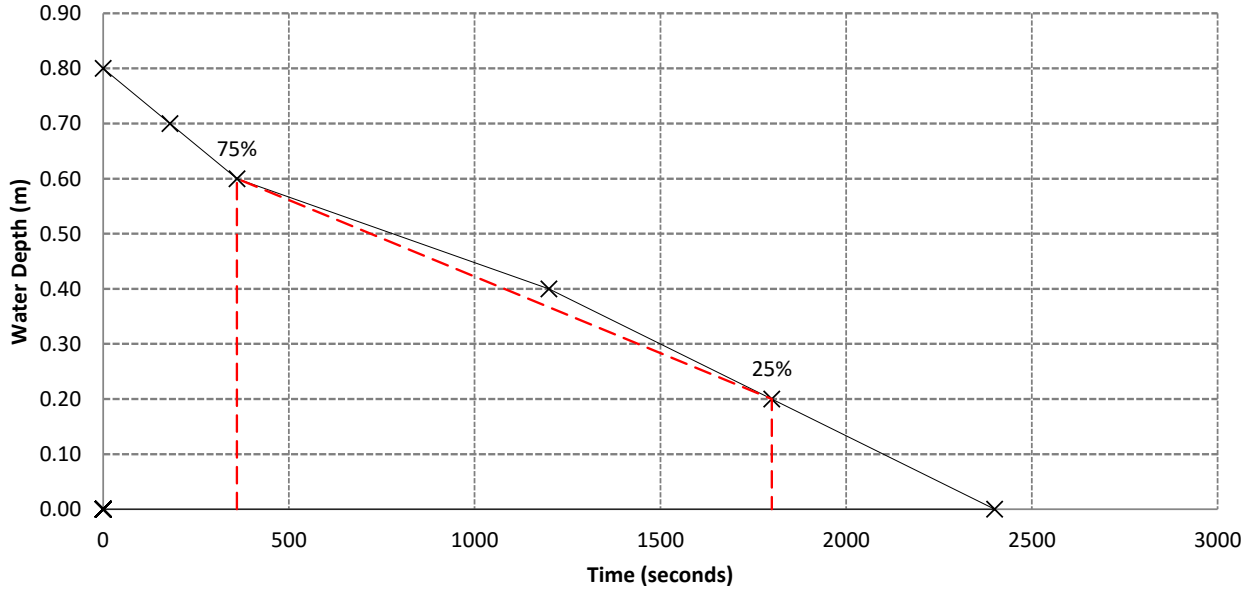
$a_{p50\%}$: Internal surface area of pite up to 50% effective depth, including base area

$t_{p75\text{-}25}$: Time for water to dall from 75% to 25% effective depth

$V_{p75\text{-}25}$: Effective storage volume between 75% & 25% effective depth

q= **1.02E-04** m/sec

0.366 m/hr



Engineering & Development Solutions	Job No.	Job Name	Prepared	Date
Unit 10 Penstraze Business Centre, Truro, Cornwall, TR4 8PN Tel 07973816457	J-1846	Truro Timberframe	EDS	19/02/2020

Pit Dimensions

Depth (m)	Length (m)	Width (m)
2.00	2.00	0.60

Test Date:	17/02/2021
Trial Pit No.:	TP1
Test No.:	2

Soakaway test - tabulated data

Time (hh:mm)	Depth to Water (m)	Elapsed Time (sec)	Water Depth (m)	% Effective	Volume (m^3)
09:56	1.00	0	0.90	100%	1.08
09:58	1.10	120	0.80	89%	0.96
10:10	1.20	840	0.70	78%	0.84
10:24	1.40	1680	0.50	56%	0.60
10:35	1.60	2340	0.30	33%	0.36
10:47	1.80	3060	0.10	11%	0.12
10:52	1.90	3360	0.00	0%	0.00

% Effective	Vol (m^3)	T (sec)
78%	0.84	840
56%	0.60	1680
75%	0.81	945
33%	0.36	2340
11%	0.12	3060
25%	0.27	2610
75%-25%	0.54	1665

Effective Values Summary

Datum (0,0) is ground level at pit

Initial Depth	1.00	m (below datum)
Final Depth	1.90	m (below datum)
Storage Depth	0.90	m (effective depth)
$a_{p50\%}$	3.54	m^2

$$q = \frac{V_{p75\text{-}25}}{a_{p50} \times t_{p75\text{-}25}}$$

Where:

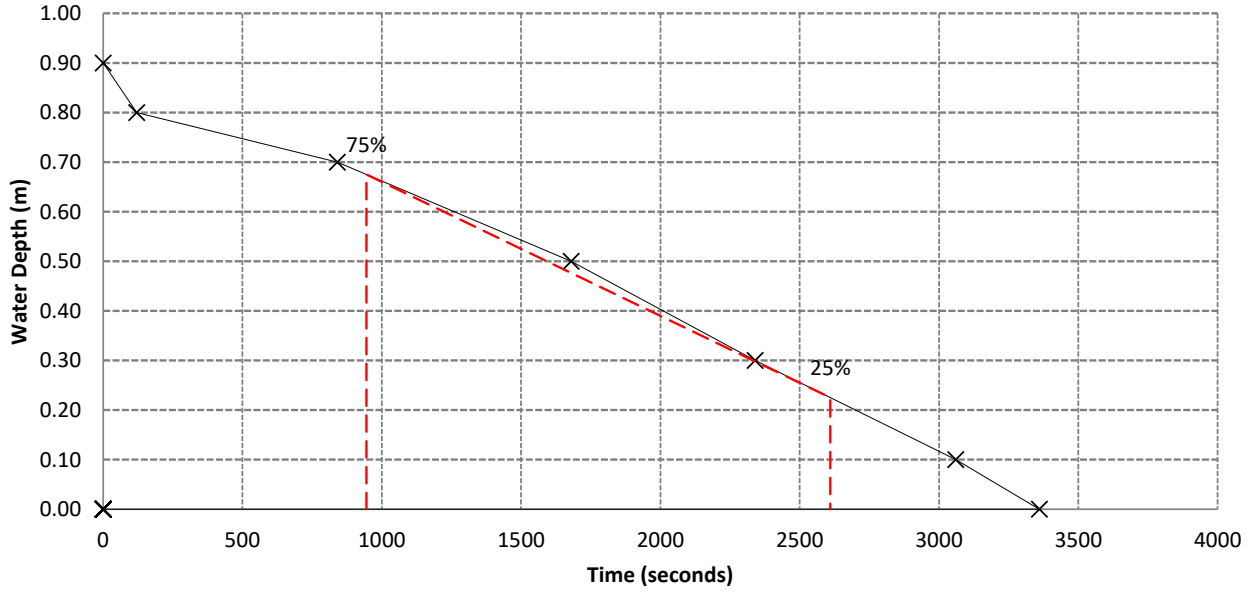
$a_{p50\%}$: Internal surface area of pite up to 50% effective depth, including base area

$t_{p75\text{-}25}$: Time for water to dall from 75% to 25% effective depth

$V_{p75\text{-}25}$: Effective storage volume between 75% & 25% effective depth

q= **9.16E-05** m/sec

0.330 m/hr



Engineering & Development Solutions	Job No.	Job Name	Prepared	Date
Unit 10 Penstraze Business Centre, Truro, Cornwall, TR4 8PN Tel 07973816457	J-1846	Truro Timberframe	EDS	19/02/2020

Pit Dimensions

Depth (m)	Length (m)	Width (m)
2.00	2.00	0.60

Test Date:	17/02/2021
Trial Pit No.:	TP1
Test No.:	3

Soakaway test - tabulated data

Time (hh:mm)	Depth to Water (m)	Elapsed Time (sec)	Water Depth (m)	% Effective	Volume (m^3)
10:52	1.00	0	0.70	100%	0.84
10:57	1.10	300	0.60	86%	0.72
11:11	1.30	1140	0.40	57%	0.48
11:32	1.50	2400	0.20	29%	0.24
11:42	1.60	3000	0.10	14%	0.12
11:54	1.70	3720	0.00	0%	0.00

% Effective	Vol (m^3)	T (sec)
86%	0.72	300
57%	0.48	1140
75%	0.63	615
29%	0.24	2400
14%	0.12	3000
25%	0.21	2550
75%-25%	0.42	1935

Effective Values Summary

Datum (0,0) is ground level at pit

Initial Depth	1.00	m (below datum)
Final Depth	1.70	m (below datum)
Storage Depth	0.70	m (effective depth)
$a_{p50\%}$	3.02	m^2

$$q = \frac{V_{p75\text{-}25}}{a_{p50} \times t_{p75\text{-}25}}$$

Where:

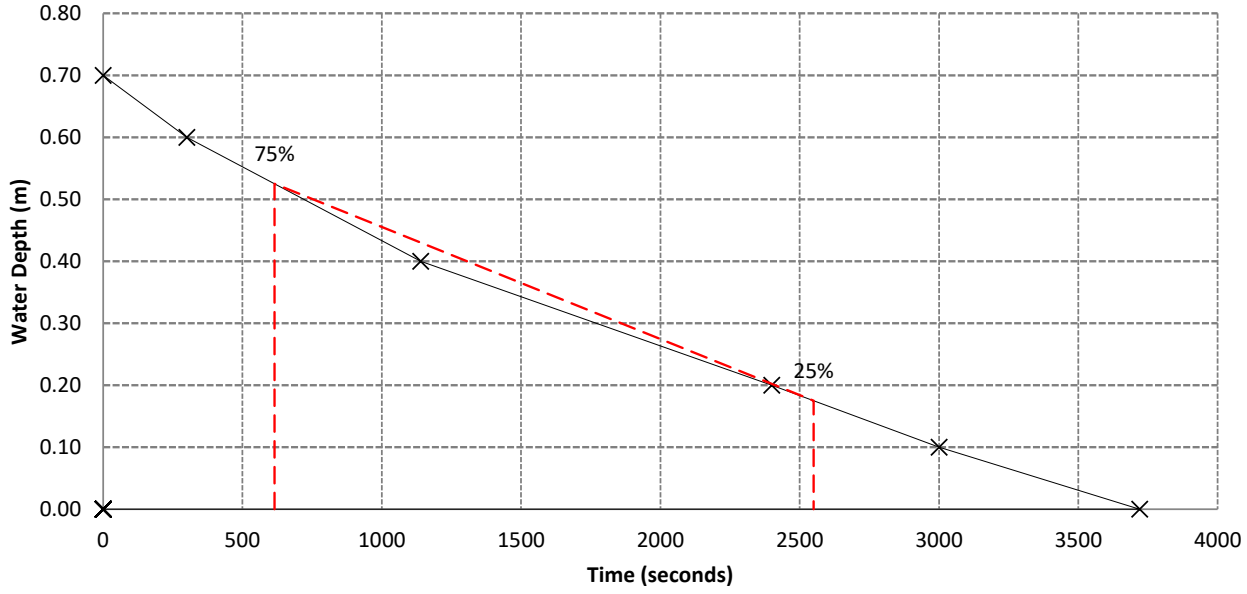
$a_{p50\%}$: Internal surface area of pite up to 50% effective depth, including base area

$t_{p75\text{-}25}$: Time for water to dall from 75% to 25% effective depth

$V_{p75\text{-}25}$: Effective storage volume between 75% & 25% effective depth

q= **7.19E-05** m/sec

0.259 m/hr



Engineering & Development Solutions	Job No.	Job Name	Prepared	Date
Unit 10 Penstraze Business Centre, Truro, Cornwall, TR4 8PN Tel 07973816457	J-1846	Truro Timberframe	EDS	19/02/2020

Pit Dimensions

Depth (m)	Length (m)	Width (m)
2.00	2.00	0.60

Test Date:	17/02/2021
Trial Pit No.:	TP2
Test No.:	1

Soakaway test - tabulated data

Time (hh:mm)	Depth to Water (m)	Elapsed Time (sec)	Water Depth (m)	% Effective	Volume (m^3)
09:35	1.20	0	0.60	100%	0.72
09:36	1.40	60	0.40	67%	0.48
09:37	1.60	120	0.20	33%	0.24
09:38	1.80	180	0.00	0%	0.00

% Effective	Vol (m^3)	T (sec)
100%	0.72	0
67%	0.48	60
75%	0.54	45
33%	0.24	120
0%	0.00	180
25%	0.18	135
75%-25%	0.36	90

Effective Values Summary

Datum (0,0) is ground level at pit

Initial Depth	1.20	m (below datum)
Final Depth	1.80	m (below datum)
Storage Depth	0.60	m (effective depth)
$a_{p50\%}$	2.76	m^2

$$q = \frac{V_{p75-25}}{a_{p50} \times t_{p75-25}}$$

Where:

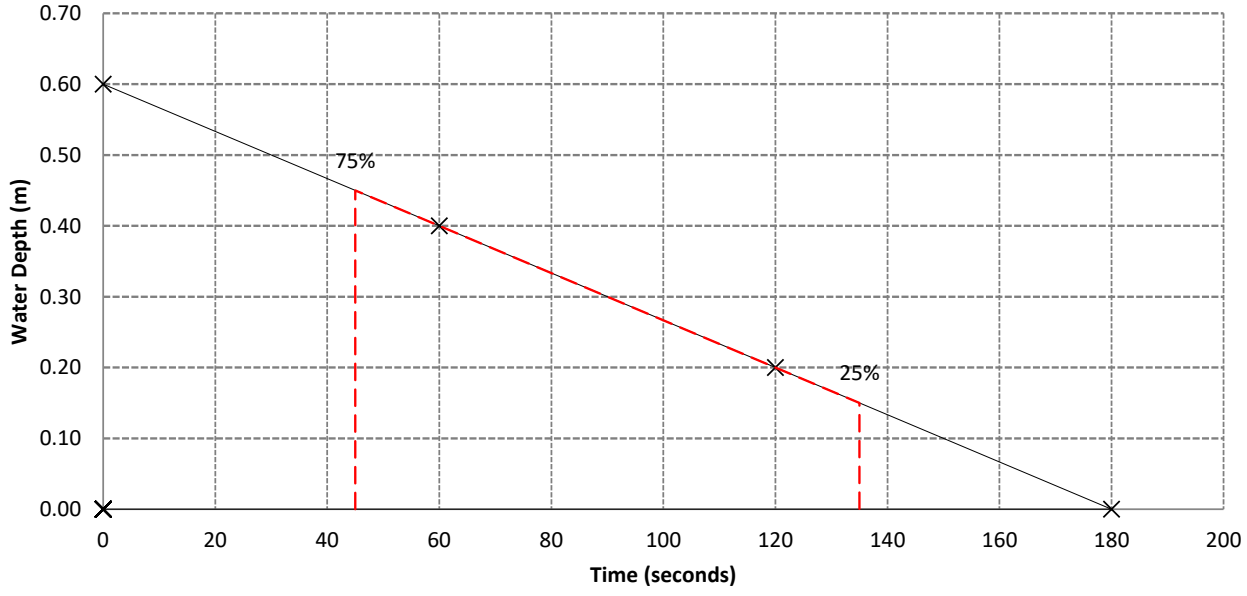
$a_{p50\%}$: Internal surface area of pite up to 50% effective depth, including base area

t_{p75-25}: Time for water to dall from 75% to 25% effective depth

V_{p75-25}: Effective storage volume between 75% & 25% effective depth

q= **1.45E-03** m/sec

5.217 m/hr



Engineering & Development Solutions	Job No.	Job Name	Prepared	Date
Unit 10 Penstraze Business Centre, Truro, Cornwall, TR4 8PN Tel 07973816457	J-1846	Truro Timberframe	EDS	19/02/2020

Pit Dimensions

Depth (m)	Length (m)	Width (m)
2.00	2.00	0.60

Test Date:	17/02/2021
Trial Pit No.:	TP2
Test No.:	2

Soakaway test - tabulated data

Time (hh:mm)	Depth to Water (m)	Elapsed Time (sec)	Water Depth (m)	% Effective	Volume (m^3)
09:39	1.20	0	0.60	100%	0.72
09:40	1.40	60	0.40	67%	0.48
09:41	1.60	120	0.20	33%	0.24
09:42	1.80	180	0.00	0%	0.00

% Effective	Vol (m^3)	T (sec)
100%	0.72	0
67%	0.48	60
75%	0.54	45
33%	0.24	120
0%	0.00	180
25%	0.18	135
75%-25%	0.36	90

Effective Values Summary

Datum (0,0) is ground level at pit

Initial Depth	1.20	m (below datum)
Final Depth	1.80	m (below datum)
Storage Depth	0.60	m (effective depth)
$a_{p50\%}$	2.76	m^2

$$q = \frac{V_{p75-25}}{a_{p50} \times t_{p75-25}}$$

Where:

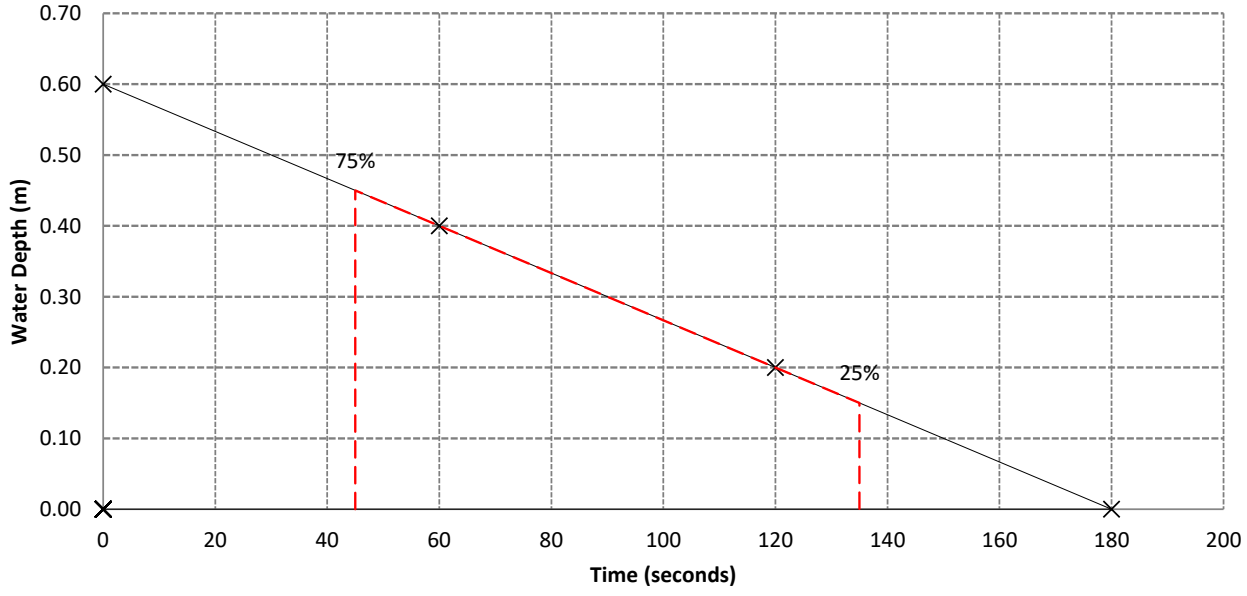
$a_{p50\%}$: Internal surface area of pite up to 50% effective depth, including base area

t_{p75-25}: Time for water to dall from 75% to 25% effective depth

V_{p75-25}: Effective storage volume between 75% & 25% effective depth

q= **1.45E-03** m/sec

5.217 m/hr



Engineering & Development Solutions	Job No.	Job Name	Prepared	Date
Unit 10 Penstraze Business Centre, Truro, Cornwall, TR4 8PN Tel 07973816457	J-1846	Truro Timberframe	EDS	19/02/2020

Pit Dimensions

Depth (m)	Length (m)	Width (m)
2.00	2.00	0.60

Test Date:	17/02/2021
Trial Pit No.:	TP2
Test No.:	3

Soakaway test - tabulated data

Time (hh:mm)	Depth to Water (m)	Elapsed Time (sec)	Water Depth (m)	% Effective	Volume (m^3)
09:42	1.20	0	0.60	100%	0.72
09:43	1.40	60	0.40	67%	0.48
09:44	1.60	120	0.20	33%	0.24
09:45	1.80	180	0.00	0%	0.00

% Effective	Vol (m^3)	T (sec)
100%	0.72	0
67%	0.48	60
75%	0.54	45
33%	0.24	120
0%	0.00	180
25%	0.18	135
75%-25%	0.36	90

Effective Values Summary

Datum (0,0) is ground level at pit

Initial Depth	1.20	m (below datum)
Final Depth	1.80	m (below datum)
Storage Depth	0.60	m (effective depth)
$a_{p50\%}$	2.76	m^2

$$q = \frac{V_{p75-25}}{a_{p50} \times t_{p75-25}}$$

Where:

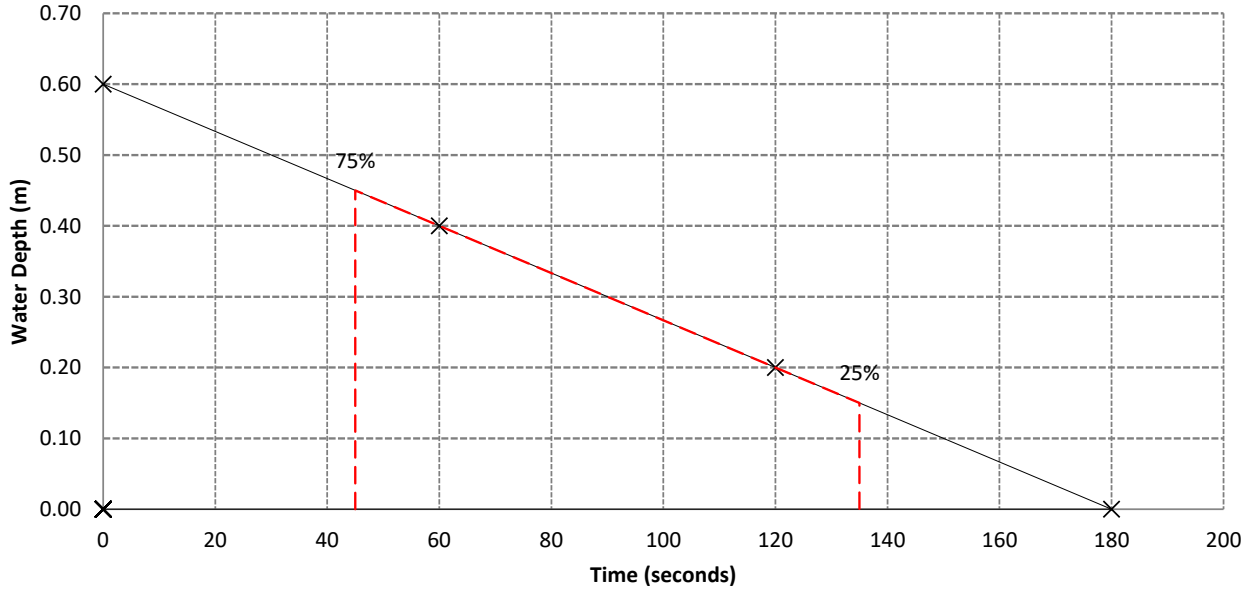
$a_{p50\%}$: Internal surface area of pite up to 50% effective depth, including base area

t_{p75-25}: Time for water to dall from 75% to 25% effective depth

V_{p75-25}: Effective storage volume between 75% & 25% effective depth

q= **1.45E-03** m/sec

5.217 m/hr



Engineering & Development Solutions	Job No.	Job Name	Prepared	Date
Unit 10 Penstraze Business Centre, Truro, Cornwall, TR4 8PN Tel 07973816457	J-1846	Truro Timberframe	EDS	19/02/2020

Pit Dimensions

Depth (m)	Length (m)	Width (m)
2.20	2.00	0.60

Test Date:	17/02/2021
Trial Pit No.:	TP3
Test No.:	1

Soakaway test - tabulated data

Time (hh:mm)	Depth to Water (m)	Elapsed Time (sec)	Water Depth (m)	% Effective	Volume (m^3)
10:12	1.30	0	0.80	100%	0.96
10:13	1.50	60	0.60	75%	0.72
10:14	1.60	120	0.50	63%	0.60
10:16	1.80	240	0.30	38%	0.36
10:21	2.10	540	0.00	0%	0.00

% Effective	Vol (m^3)	T (sec)
100%	0.96	0
75%	0.72	60
75%	0.72	60
38%	0.36	240
0%	0.00	540
25%	0.24	340
75%-25%	0.48	280

Effective Values Summary

Datum (0,0) is ground level at pit

Initial Depth	1.30	m (below datum)
Final Depth	2.10	m (below datum)
Storage Depth	0.80	m (effective depth)
$a_{p50\%}$	3.28	m^2

$$q = \frac{V_{p75-25}}{a_{p50} \times t_{p75-25}}$$

Where:

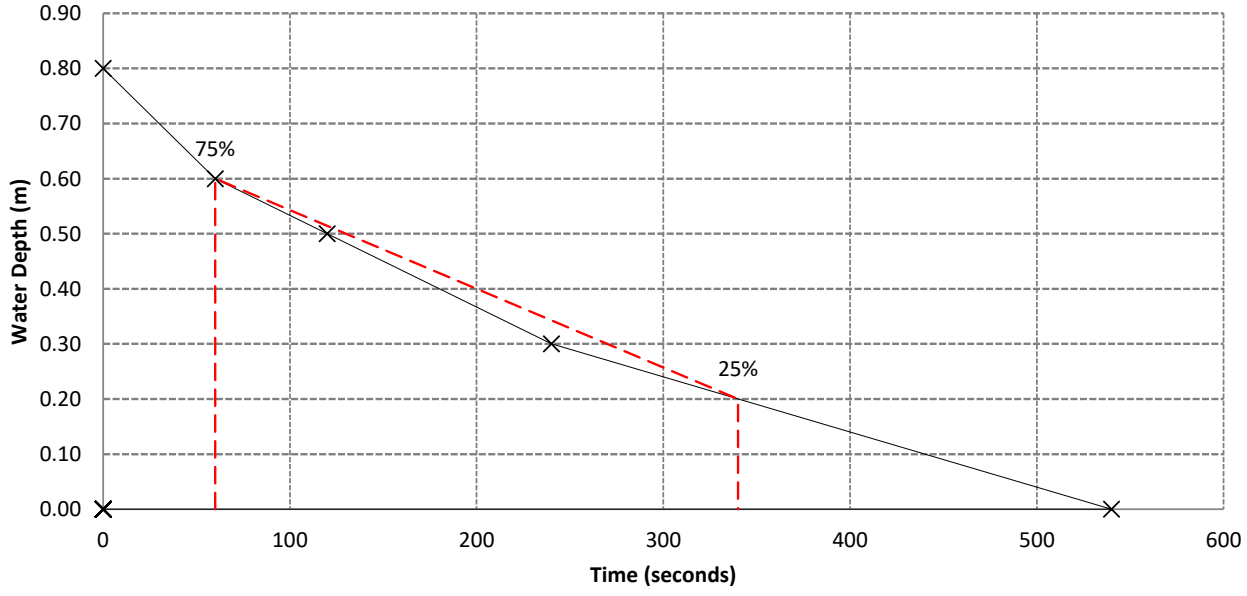
$a_{p50\%}$: Internal surface area of pite up to 50% effective depth, including base area

t_{p75-25}: Time for water to dall from 75% to 25% effective depth

V_{p75-25}: Effective storage volume between 75% & 25% effective depth

q= **5.23E-04** m/sec

1.882 m/hr



Engineering & Development Solutions	Job No.	Job Name	Prepared	Date
Unit 10 Penstraze Business Centre, Truro, Cornwall, TR4 8PN Tel 07973816457	J-1846	Truro Timberframe	EDS	19/02/2020

Pit Dimensions

Depth (m)	Length (m)	Width (m)
2.20	2.00	0.60

Test Date:	17/02/2021
Trial Pit No.:	TP3
Test No.:	2

Soakaway test - tabulated data

Time (hh:mm)	Depth to Water (m)	Elapsed Time (sec)	Water Depth (m)	% Effective	Volume (m^3)
10:22	1.40	0	0.70	100%	0.84
10:24	1.60	120	0.50	71%	0.60
10:26	1.80	240	0.30	43%	0.36
10:27	1.90	300	0.20	29%	0.24
10:28	2.00	360	0.10	14%	0.12
10:32	2.10	600	0.00	0%	0.00

% Effective	Vol (m^3)	T (sec)
100%	0.84	0
71%	0.60	120
75%	0.63	105
29%	0.24	300
14%	0.12	360
25%	0.21	315
75%-25%	0.42	210

Effective Values Summary

Datum (0,0) is ground level at pit

Initial Depth	1.40	m (below datum)
Final Depth	2.10	m (below datum)
Storage Depth	0.70	m (effective depth)
$a_{p50\%}$	3.02	m^2

$$q = \frac{V_{p75\text{-}25}}{a_{p50} \times t_{p75\text{-}25}}$$

Where:

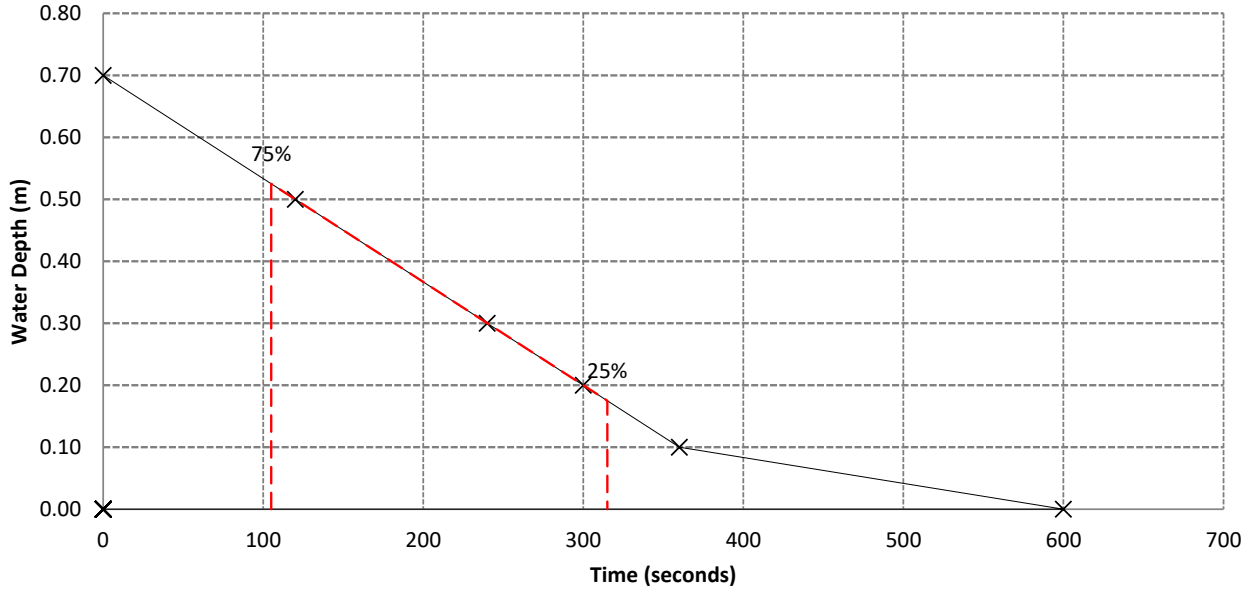
$a_{p50\%}$: Internal surface area of pite up to 50% effective depth, including base area

$t_{p75\text{-}25}$: Time for water to dall from 75% to 25% effective depth

$V_{p75\text{-}25}$: Effective storage volume between 75% & 25% effective depth

q= **6.62E-04** m/sec

2.384 m/hr



Engineering & Development Solutions	Job No.	Job Name	Prepared	Date
Unit 10 Penstraze Business Centre, Truro, Cornwall, TR4 8PN Tel 07973816457	J-1846	Truro Timberframe	EDS	19/02/2020

Pit Dimensions

Depth (m)	Length (m)	Width (m)
2.20	2.00	0.60

Test Date:	17/02/2021
Trial Pit No.:	TP3
Test No.:	3

Soakaway test - tabulated data

Time (hh:mm)	Depth to Water (m)	Elapsed Time (sec)	Water Depth (m)	% Effective	Volume (m^3)
10:22	1.40	0	0.70	100%	0.84
10:36	1.60	840	0.50	71%	0.60
10:38	1.70	960	0.40	57%	0.48
10:40	1.80	1080	0.30	43%	0.36
10:42	1.90	1200	0.20	29%	0.24
10:45	2.00	1380	0.10	14%	0.12
10:47	2.10	1500	0.00	0%	0.00

% Effective	Vol (m^3)	T (sec)
100%	0.84	0
71%	0.60	840
75%	0.63	735
29%	0.24	1200
14%	0.12	1380
25%	0.21	1245
75%-25%	0.42	510

Effective Values Summary

Datum (0,0) is ground level at pit

Initial Depth	1.40	m (below datum)
Final Depth	2.10	m (below datum)
Storage Depth	0.70	m (effective depth)
$a_{p50\%}$	3.02	m^2

$$q = \frac{V_{p75-25}}{a_{p50} \times t_{p75-25}}$$

Where:

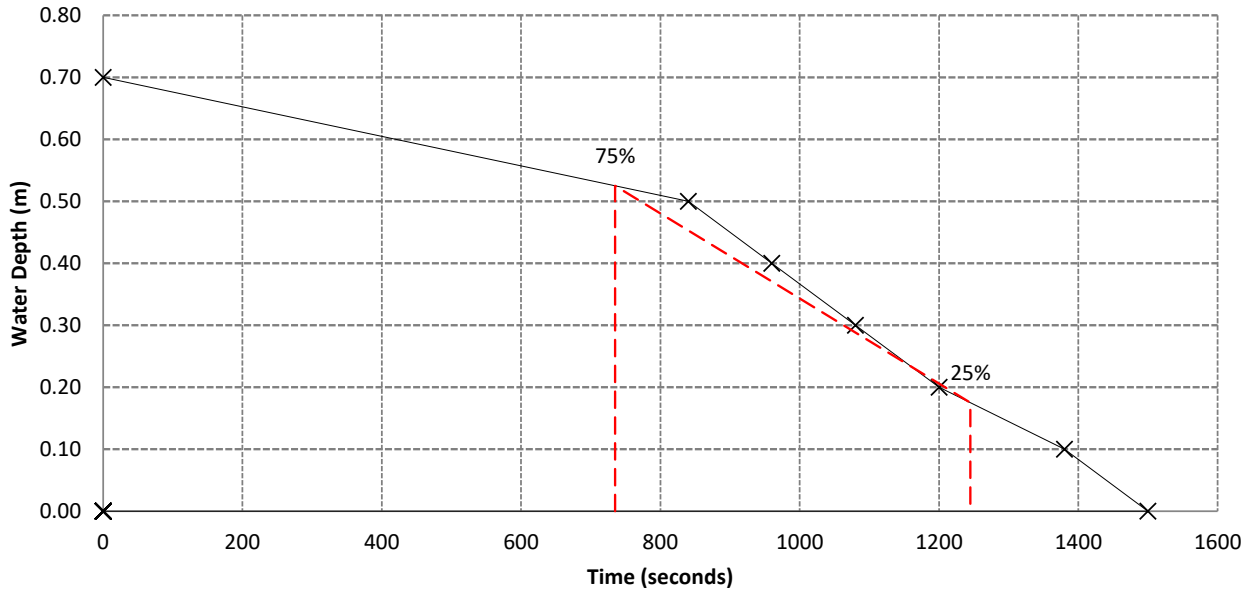
$a_{p50\%}$: Internal surface area of pite up to 50% effective depth, including base area

t_{p75-25}: Time for water to dall from 75% to 25% effective depth

V_{p75-25}: Effective storage volume between 75% & 25% effective depth

q= **2.73E-04** m/sec

0.982 m/hr



Summary of Infiltration Testing

ADAS Appendix 5 Permeability Descriptions (for average 2m x .6m x 2m dp pit)

Permeability Description	low (m/day)	high (m/day)
Very Slow	0.01	0.10
Slow-moderate	0.1	0.30
Moderate	0.3	1.00
Mod-rapid	1.0	10.0
Very rapid	10	

low (m/hr)	high (m/hr)	low (m/s)	high (m/s)
0.000	0.004	1.2E-07	1.2E-06
0.004	0.013	1.2E-06	3.5E-06
0.013	0.042	3.5E-06	1.2E-05
0.042	0.417	1.2E-05	1.2E-04
0.417		1.2E-04	

Table 1.0 Summary of results

Trial Pit	Infiltration Q, m/sec		
	Test 1	Test 2	Test 3
TP1	1.02E-04	9.16E-05	7.19E-05
TP2	1.45E-03	1.45E-03	1.45E-03
TP3	5.23E-04	6.62E-04	2.73E-04
TP4			

Q, m/s (min)	m/hr	m/day	Description
7.19E-05	0.26	6.21	Mod-rapid
1.45E-03	5.22	125.22	Very rapid
2.73E-04	0.98	23.56	Very rapid

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

Half Drain Time : 111 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	93.474	0.774	2.4	18.4	O K
30 min Summer	93.725	1.025	2.8	24.4	O K
60 min Summer	93.943	1.243	3.1	29.5	O K
120 min Summer	94.070	1.370	3.2	32.5	O K
180 min Summer	94.097	1.397	3.3	33.2	O K
240 min Summer	94.085	1.385	3.3	32.9	O K
360 min Summer	94.020	1.320	3.2	31.4	O K
480 min Summer	93.956	1.256	3.1	29.8	O K
600 min Summer	93.891	1.191	3.0	28.3	O K
720 min Summer	93.828	1.128	2.9	26.8	O K
960 min Summer	93.709	1.009	2.7	24.0	O K
1440 min Summer	93.507	0.807	2.5	19.2	O K
2160 min Summer	93.278	0.578	2.2	13.7	O K
2880 min Summer	93.110	0.410	1.9	9.7	O K
4320 min Summer	92.890	0.190	1.6	4.5	O K
5760 min Summer	92.773	0.073	1.5	1.7	O K
7200 min Summer	92.745	0.045	1.3	1.1	O K
8640 min Summer	92.740	0.040	1.1	0.9	O K
10080 min Summer	92.735	0.035	1.0	0.8	O K
15 min Winter	93.574	0.874	2.6	20.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	105.081	0.0	21
30 min Summer	72.649	0.0	34
60 min Summer	48.121	0.0	62
120 min Summer	30.859	0.0	98
180 min Summer	23.450	0.0	132
240 min Summer	19.153	0.0	166
360 min Summer	14.270	0.0	236
480 min Summer	11.585	0.0	304
600 min Summer	9.845	0.0	372
720 min Summer	8.614	0.0	438
960 min Summer	6.969	0.0	570
1440 min Summer	5.157	0.0	824
2160 min Summer	3.806	0.0	1192
2880 min Summer	3.062	0.0	1560
4320 min Summer	2.249	0.0	2252
5760 min Summer	1.804	0.0	2944
7200 min Summer	1.523	0.0	3648
8640 min Summer	1.326	0.0	4376
10080 min Summer	1.180	0.0	4992
15 min Winter	105.081	0.0	21

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	93.863	1.163	3.0	27.6	O K
60 min Winter	94.121	1.421	3.3	33.8	O K
120 min Winter	94.270	1.570	3.5	37.3	O K
180 min Winter	94.299	1.599	3.5	38.0	O K
240 min Winter	94.275	1.575	3.5	37.4	O K
360 min Winter	94.169	1.469	3.4	34.9	O K
480 min Winter	94.063	1.363	3.2	32.4	O K
600 min Winter	93.962	1.262	3.1	30.0	O K
720 min Winter	93.867	1.167	3.0	27.7	O K
960 min Winter	93.694	0.994	2.7	23.6	O K
1440 min Winter	93.419	0.719	2.3	17.1	O K
2160 min Winter	93.131	0.431	2.0	10.2	O K
2880 min Winter	92.936	0.236	1.7	5.6	O K
4320 min Winter	92.748	0.048	1.4	1.1	O K
5760 min Winter	92.739	0.039	1.1	0.9	O K
7200 min Winter	92.733	0.033	0.9	0.8	O K
8640 min Winter	92.729	0.029	0.8	0.7	O K
10080 min Winter	92.725	0.025	0.7	0.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	72.649	0.0	34
60 min Winter	48.121	0.0	60
120 min Winter	30.859	0.0	102
180 min Winter	23.450	0.0	140
240 min Winter	19.153	0.0	178
360 min Winter	14.270	0.0	254
480 min Winter	11.585	0.0	326
600 min Winter	9.845	0.0	398
720 min Winter	8.614	0.0	466
960 min Winter	6.969	0.0	600
1440 min Winter	5.157	0.0	864
2160 min Winter	3.806	0.0	1236
2880 min Winter	3.062	0.0	1588
4320 min Winter	2.249	0.0	2196
5760 min Winter	1.804	0.0	2848
7200 min Winter	1.523	0.0	3656
8640 min Winter	1.326	0.0	4272
10080 min Winter	1.180	0.0	5136

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	17.100	Shortest Storm (mins)	15
Ratio R	0.300	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.104

Time From: (mins)	To:	Area (ha)	Time From: (mins)	To:	Area (ha)
0	4	0.052	4	8	0.052

Model Details

Storage is Online Cover Level (m) 95.200

Cellular Storage Structure

Invert Level (m) 92.700 Safety Factor 5.0
Infiltration Coefficient Base (m/hr) 0.98200 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.98200

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	25.0	25.0	1.601	0.0	65.0
1.600	25.0	65.0			

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

Half Drain Time : 134 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	90.449	0.749	3.0	25.6	O K
30 min Summer	90.697	0.997	3.4	34.1	O K
60 min Summer	90.922	1.222	3.7	41.8	O K
120 min Summer	91.057	1.357	3.9	46.4	O K
180 min Summer	91.087	1.387	3.9	47.5	O K
240 min Summer	91.080	1.380	3.9	47.2	O K
360 min Summer	91.025	1.325	3.8	45.3	O K
480 min Summer	90.968	1.268	3.8	43.4	O K
600 min Summer	90.910	1.210	3.7	41.4	O K
720 min Summer	90.851	1.151	3.6	39.4	O K
960 min Summer	90.737	1.037	3.4	35.5	O K
1440 min Summer	90.535	0.835	3.1	28.6	O K
2160 min Summer	90.296	0.596	2.8	20.4	O K
2880 min Summer	90.117	0.417	2.6	14.3	O K
4320 min Summer	89.880	0.180	2.2	6.2	O K
5760 min Summer	89.763	0.063	2.1	2.2	O K
7200 min Summer	89.744	0.044	1.8	1.5	O K
8640 min Summer	89.738	0.038	1.6	1.3	O K
10080 min Summer	89.734	0.034	1.4	1.2	O K
15 min Winter	90.546	0.846	3.2	28.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	105.081	0.0	21
30 min Summer	72.649	0.0	34
60 min Summer	48.121	0.0	62
120 min Summer	30.859	0.0	104
180 min Summer	23.450	0.0	136
240 min Summer	19.153	0.0	170
360 min Summer	14.270	0.0	240
480 min Summer	11.585	0.0	310
600 min Summer	9.845	0.0	378
720 min Summer	8.614	0.0	446
960 min Summer	6.969	0.0	578
1440 min Summer	5.157	0.0	838
2160 min Summer	3.806	0.0	1212
2880 min Summer	3.062	0.0	1564
4320 min Summer	2.249	0.0	2256
5760 min Summer	1.804	0.0	2936
7200 min Summer	1.523	0.0	3672
8640 min Summer	1.326	0.0	4400
10080 min Summer	1.180	0.0	5048
15 min Winter	105.081	0.0	21

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	90.831	1.131	3.6	38.7	O K
60 min Winter	91.097	1.397	3.9	47.8	O K
120 min Winter	91.267	1.567	4.2	53.6	O K
180 min Winter	91.299	1.599	4.2	54.7	O K
240 min Winter	91.286	1.586	4.2	54.2	O K
360 min Winter	91.197	1.497	4.1	51.2	O K
480 min Winter	91.103	1.403	4.0	48.0	O K
600 min Winter	91.009	1.309	3.8	44.8	O K
720 min Winter	90.918	1.218	3.7	41.7	O K
960 min Winter	90.748	1.048	3.5	35.8	O K
1440 min Winter	90.463	0.763	3.0	26.1	O K
2160 min Winter	90.150	0.450	2.6	15.4	O K
2880 min Winter	89.932	0.232	2.3	7.9	O K
4320 min Winter	89.747	0.047	1.9	1.6	O K
5760 min Winter	89.738	0.038	1.5	1.3	O K
7200 min Winter	89.732	0.032	1.3	1.1	O K
8640 min Winter	89.728	0.028	1.1	0.9	O K
10080 min Winter	89.725	0.025	1.0	0.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	72.649	0.0	34
60 min Winter	48.121	0.0	62
120 min Winter	30.859	0.0	114
180 min Winter	23.450	0.0	144
240 min Winter	19.153	0.0	182
360 min Winter	14.270	0.0	260
480 min Winter	11.585	0.0	334
600 min Winter	9.845	0.0	406
720 min Winter	8.614	0.0	476
960 min Winter	6.969	0.0	614
1440 min Winter	5.157	0.0	880
2160 min Winter	3.806	0.0	1256
2880 min Winter	3.062	0.0	1612
4320 min Winter	2.249	0.0	2192
5760 min Winter	1.804	0.0	2856
7200 min Winter	1.523	0.0	3672
8640 min Winter	1.326	0.0	4368
10080 min Winter	1.180	0.0	5016

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	17.100	Shortest Storm (mins)	15
Ratio R	0.300	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.144

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.072	4	8	0.072

Model Details

Storage is Online Cover Level (m) 92.000

Cellular Storage Structure

Invert Level (m) 89.700 Safety Factor 5.0
Infiltration Coefficient Base (m/hr) 0.98200 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.98200

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	36.0	36.0	1.601	0.0	77.6
1.600	36.0	77.6			

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

Half Drain Time : 21 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	96.159	0.959	7.4	10.9	O K
30 min Summer	96.346	1.146	8.1	13.1	O K
60 min Summer	96.407	1.207	8.4	13.8	O K
120 min Summer	96.331	1.131	8.1	12.9	O K
180 min Summer	96.209	1.009	7.6	11.5	O K
240 min Summer	96.085	0.885	7.1	10.1	O K
360 min Summer	95.876	0.676	6.2	7.7	O K
480 min Summer	95.719	0.519	5.6	5.9	O K
600 min Summer	95.596	0.396	5.1	4.5	O K
720 min Summer	95.499	0.299	4.7	3.4	O K
960 min Summer	95.359	0.159	4.1	1.8	O K
1440 min Summer	95.247	0.047	3.5	0.5	O K
2160 min Summer	95.235	0.035	2.6	0.4	O K
2880 min Summer	95.228	0.028	2.1	0.3	O K
4320 min Summer	95.221	0.021	1.5	0.2	O K
5760 min Summer	95.217	0.017	1.2	0.2	O K
7200 min Summer	95.214	0.014	1.0	0.2	O K
8640 min Summer	95.212	0.012	0.9	0.1	O K
10080 min Summer	95.211	0.011	0.8	0.1	O K
15 min Winter	96.293	1.093	7.9	12.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	105.081	0.0	17
30 min Summer	72.649	0.0	26
60 min Summer	48.121	0.0	44
120 min Summer	30.859	0.0	76
180 min Summer	23.450	0.0	110
240 min Summer	19.153	0.0	142
360 min Summer	14.270	0.0	204
480 min Summer	11.585	0.0	264
600 min Summer	9.845	0.0	324
720 min Summer	8.614	0.0	384
960 min Summer	6.969	0.0	502
1440 min Summer	5.157	0.0	722
2160 min Summer	3.806	0.0	1084
2880 min Summer	3.062	0.0	1436
4320 min Summer	2.249	0.0	2172
5760 min Summer	1.804	0.0	2840
7200 min Summer	1.523	0.0	3584
8640 min Summer	1.326	0.0	4352
10080 min Summer	1.180	0.0	5032
15 min Winter	105.081	0.0	18

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	96.508	1.308	8.8	14.9	O K
60 min Winter	96.548	1.348	8.9	15.4	O K
120 min Winter	96.380	1.180	8.3	13.5	O K
180 min Winter	96.187	0.987	7.5	11.2	O K
240 min Winter	96.014	0.814	6.8	9.3	O K
360 min Winter	95.743	0.543	5.7	6.2	O K
480 min Winter	95.555	0.355	4.9	4.1	O K
600 min Winter	95.418	0.218	4.4	2.5	O K
720 min Winter	95.318	0.118	4.0	1.3	O K
960 min Winter	95.246	0.046	3.4	0.5	O K
1440 min Winter	95.234	0.034	2.5	0.4	O K
2160 min Winter	95.225	0.025	1.9	0.3	O K
2880 min Winter	95.220	0.020	1.5	0.2	O K
4320 min Winter	95.215	0.015	1.1	0.2	O K
5760 min Winter	95.212	0.012	0.9	0.1	O K
7200 min Winter	95.210	0.010	0.8	0.1	O K
8640 min Winter	95.209	0.009	0.7	0.1	O K
10080 min Winter	95.208	0.008	0.6	0.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	72.649	0.0	28
60 min Winter	48.121	0.0	46
120 min Winter	30.859	0.0	82
180 min Winter	23.450	0.0	114
240 min Winter	19.153	0.0	148
360 min Winter	14.270	0.0	210
480 min Winter	11.585	0.0	272
600 min Winter	9.845	0.0	332
720 min Winter	8.614	0.0	388
960 min Winter	6.969	0.0	490
1440 min Winter	5.157	0.0	724
2160 min Winter	3.806	0.0	1100
2880 min Winter	3.062	0.0	1448
4320 min Winter	2.249	0.0	2132
5760 min Winter	1.804	0.0	2856
7200 min Winter	1.523	0.0	3688
8640 min Winter	1.326	0.0	4272
10080 min Winter	1.180	0.0	5168

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	17.100	Shortest Storm (mins)	15
Ratio R	0.300	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.082

Time From: (mins)	To:	Area (ha)	Time From: (mins)	To:	Area (ha)
0	4	0.041	4	8	0.041

Model Details

Storage is Online Cover Level (m) 97.500

Cellular Storage Structure

Invert Level (m) 95.200 Safety Factor 5.0
Infiltration Coefficient Base (m/hr) 5.21700 Porosity 0.95
Infiltration Coefficient Side (m/hr) 5.21700

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	12.0	12.0	1.601	0.0	34.4
1.600	12.0	34.4			

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

Half Drain Time : 23 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	96.262	1.062	8.5	13.6	O K
30 min Summer	96.475	1.275	9.5	16.3	O K
60 min Summer	96.555	1.355	9.8	17.4	O K
120 min Summer	96.482	1.282	9.5	16.4	O K
180 min Summer	96.356	1.156	8.9	14.8	O K
240 min Summer	96.225	1.025	8.4	13.1	O K
360 min Summer	96.000	0.800	7.4	10.3	O K
480 min Summer	95.829	0.629	6.6	8.1	O K
600 min Summer	95.694	0.494	6.1	6.3	O K
720 min Summer	95.586	0.386	5.6	5.0	O K
960 min Summer	95.426	0.226	4.9	2.9	O K
1440 min Summer	95.256	0.056	4.2	0.7	O K
2160 min Summer	95.238	0.038	3.1	0.5	O K
2880 min Summer	95.231	0.031	2.5	0.4	O K
4320 min Summer	95.222	0.022	1.8	0.3	O K
5760 min Summer	95.218	0.018	1.5	0.2	O K
7200 min Summer	95.215	0.015	1.3	0.2	O K
8640 min Summer	95.213	0.013	1.1	0.2	O K
10080 min Summer	95.212	0.012	1.0	0.2	O K
15 min Winter	96.409	1.209	9.2	15.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	105.081	0.0	17
30 min Summer	72.649	0.0	27
60 min Summer	48.121	0.0	44
120 min Summer	30.859	0.0	78
180 min Summer	23.450	0.0	110
240 min Summer	19.153	0.0	142
360 min Summer	14.270	0.0	204
480 min Summer	11.585	0.0	266
600 min Summer	9.845	0.0	326
720 min Summer	8.614	0.0	386
960 min Summer	6.969	0.0	504
1440 min Summer	5.157	0.0	736
2160 min Summer	3.806	0.0	1088
2880 min Summer	3.062	0.0	1440
4320 min Summer	2.249	0.0	2128
5760 min Summer	1.804	0.0	2896
7200 min Summer	1.523	0.0	3584
8640 min Summer	1.326	0.0	4272
10080 min Summer	1.180	0.0	4992
15 min Winter	105.081	0.0	18

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	96.656	1.456	10.2	18.7	O K
60 min Winter	96.717	1.517	10.5	19.5	O K
120 min Winter	96.550	1.350	9.8	17.3	O K
180 min Winter	96.346	1.146	8.9	14.7	O K
240 min Winter	96.160	0.960	8.1	12.3	O K
360 min Winter	95.866	0.666	6.8	8.5	O K
480 min Winter	95.659	0.459	5.9	5.9	O K
600 min Winter	95.506	0.306	5.2	3.9	O K
720 min Winter	95.389	0.189	4.7	2.4	O K
960 min Winter	95.250	0.050	4.1	0.6	O K
1440 min Winter	95.237	0.037	3.1	0.5	O K
2160 min Winter	95.227	0.027	2.3	0.4	O K
2880 min Winter	95.222	0.022	1.8	0.3	O K
4320 min Winter	95.216	0.016	1.3	0.2	O K
5760 min Winter	95.213	0.013	1.1	0.2	O K
7200 min Winter	95.211	0.011	0.9	0.1	O K
8640 min Winter	95.210	0.010	0.8	0.1	O K
10080 min Winter	95.209	0.009	0.7	0.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	72.649	0.0	28
60 min Winter	48.121	0.0	46
120 min Winter	30.859	0.0	82
180 min Winter	23.450	0.0	116
240 min Winter	19.153	0.0	148
360 min Winter	14.270	0.0	212
480 min Winter	11.585	0.0	274
600 min Winter	9.845	0.0	334
720 min Winter	8.614	0.0	392
960 min Winter	6.969	0.0	490
1440 min Winter	5.157	0.0	734
2160 min Winter	3.806	0.0	1092
2880 min Winter	3.062	0.0	1456
4320 min Winter	2.249	0.0	2160
5760 min Winter	1.804	0.0	2968
7200 min Winter	1.523	0.0	3648
8640 min Winter	1.326	0.0	4400
10080 min Winter	1.180	0.0	5064

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	17.100	Shortest Storm (mins)	15
Ratio R	0.300	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.100

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.050	4	8	0.050

Model Details

Storage is Online Cover Level (m) 97.500

Cellular Storage Structure

Invert Level (m) 95.200 Safety Factor 5.0
Infiltration Coefficient Base (m/hr) 5.21700 Porosity 0.95
Infiltration Coefficient Side (m/hr) 5.21700

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	13.5	13.5	1.601	0.0	37.5
1.600	13.5	37.5			

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

Half Drain Time : 489 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	95.686	0.486	1.1	27.7	O K
30 min Summer	95.864	0.664	1.2	37.8	O K
60 min Summer	96.057	0.857	1.3	48.8	O K
120 min Summer	96.247	1.047	1.4	59.7	O K
180 min Summer	96.341	1.141	1.4	65.0	O K
240 min Summer	96.389	1.189	1.4	67.8	O K
360 min Summer	96.418	1.218	1.5	69.4	O K
480 min Summer	96.423	1.223	1.5	69.7	O K
600 min Summer	96.420	1.220	1.5	69.5	O K
720 min Summer	96.411	1.211	1.5	69.0	O K
960 min Summer	96.384	1.184	1.4	67.5	O K
1440 min Summer	96.322	1.122	1.4	63.9	O K
2160 min Summer	96.225	1.025	1.4	58.4	O K
2880 min Summer	96.130	0.930	1.3	53.0	O K
4320 min Summer	95.956	0.756	1.2	43.1	O K
5760 min Summer	95.807	0.607	1.2	34.6	O K
7200 min Summer	95.685	0.485	1.1	27.7	O K
8640 min Summer	95.583	0.383	1.1	21.8	O K
10080 min Summer	95.498	0.298	1.0	17.0	O K
15 min Winter	95.746	0.546	1.1	31.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	105.081	0.0	22
30 min Summer	72.649	0.0	37
60 min Summer	48.121	0.0	66
120 min Summer	30.859	0.0	124
180 min Summer	23.450	0.0	184
240 min Summer	19.153	0.0	242
360 min Summer	14.270	0.0	352
480 min Summer	11.585	0.0	408
600 min Summer	9.845	0.0	470
720 min Summer	8.614	0.0	534
960 min Summer	6.969	0.0	672
1440 min Summer	5.157	0.0	952
2160 min Summer	3.806	0.0	1364
2880 min Summer	3.062	0.0	1764
4320 min Summer	2.249	0.0	2552
5760 min Summer	1.804	0.0	3296
7200 min Summer	1.523	0.0	4040
8640 min Summer	1.326	0.0	4760
10080 min Summer	1.180	0.0	5448
15 min Winter	105.081	0.0	22

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	95.947	0.747	1.2	42.6	O K
60 min Winter	96.167	0.967	1.3	55.1	O K
120 min Winter	96.389	1.189	1.4	67.8	O K
180 min Winter	96.502	1.302	1.5	74.2	O K
240 min Winter	96.563	1.363	1.5	77.7	O K
360 min Winter	96.611	1.411	1.6	80.4	O K
480 min Winter	96.621	1.421	1.6	81.0	O K
600 min Winter	96.613	1.413	1.6	80.5	O K
720 min Winter	96.603	1.403	1.5	80.0	O K
960 min Winter	96.567	1.367	1.5	77.9	O K
1440 min Winter	96.469	1.269	1.5	72.3	O K
2160 min Winter	96.319	1.119	1.4	63.8	O K
2880 min Winter	96.174	0.974	1.3	55.5	O K
4320 min Winter	95.920	0.720	1.2	41.1	O K
5760 min Winter	95.715	0.515	1.1	29.4	O K
7200 min Winter	95.553	0.353	1.0	20.1	O K
8640 min Winter	95.424	0.224	1.0	12.8	O K
10080 min Winter	95.325	0.125	0.9	7.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	72.649	0.0	36
60 min Winter	48.121	0.0	64
120 min Winter	30.859	0.0	122
180 min Winter	23.450	0.0	180
240 min Winter	19.153	0.0	236
360 min Winter	14.270	0.0	348
480 min Winter	11.585	0.0	452
600 min Winter	9.845	0.0	492
720 min Winter	8.614	0.0	564
960 min Winter	6.969	0.0	720
1440 min Winter	5.157	0.0	1026
2160 min Winter	3.806	0.0	1472
2880 min Winter	3.062	0.0	1900
4320 min Winter	2.249	0.0	2688
5760 min Winter	1.804	0.0	3464
7200 min Winter	1.523	0.0	4184
8640 min Winter	1.326	0.0	4920
10080 min Winter	1.180	0.0	5544

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	17.100	Shortest Storm (mins)	15
Ratio R	0.300	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.146

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.073	4	8	0.073

Model Details

Storage is Online Cover Level (m) 97.500

Cellular Storage Structure

Invert Level (m) 95.200 Safety Factor 5.0
Infiltration Coefficient Base (m/hr) 0.25900 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.25900

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	60.0	60.0	1.601	0.0	114.4
1.600	60.0	114.4			

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