
DRAINAGE STRATEGY

For

PLYMOUTH HOUSE, MERTHYR TYDFIL

REF : IR20062-DS1

JUNE 2020

Prepared by :

Intrado

Castle House, 63/69 Cardiff Road

Taffs Well, Cardiff. CF15 7RD

Tel: 02920 811097

Email : admin@intrado.co.uk

Status		Prepared		Checked		Approved	
Issue	Rev	Name	Date	Name	Date	Name	Date
First	-	C. L. Cooke	26/06/2020	D.Sparkes	26/06/2020	C. L. Cooke	26/06/2020
Second							

CONTENTS

1. Introduction.....	1
2. The Site.....	2
3. Assessment of flood risk.....	3
4. Surface Water Drainage Strategy.....	5
5. Principal Operation and Maintenance Requirements.....	9
5.1 Pervious Pavement.....	9
5.2 Bioretention Area.....	12
5.3 Underground Piped Systems.....	13
6. Conclusions.....	14
7. Appendix A.....	15
Infiltration Rates.....	15
8. Appendix B.....	16
Microdrainage Calculations.....	16
9. Appendix C.....	17
Drainage Layout IR20062/100 P1.....	17
10. Appendix D.....	18
Landscape Plan.....	18

1. Introduction

Intrado Consulting Engineers have been appointed to submit a SAB application for the works associated with planning permission for 4 houses at Plymouth House, Merthyr Tydfil.

This report is produced for the sole benefit of David Rees from whom it was commissioned and has been prepared in response to their particular requirements and brief. This report may not be relied upon by any other party.

The Contracts (Rights of Third Parties) Act 1999 shall not apply to this report and the provisions of the said Act are expressly excluded from this report. This report may not be used for any purpose other than that for which it was commissioned.

This report may not be reproduced and/or made public by print, photocopy or any other means without the prior written permission of Intrado Ltd.

2. The Site

2.1 Site location & description

The site is at National Grid reference (NGR) 305567 205096, on land adjacent to 2 Plymouth House, Milbourne Terrace, Merthyr Tydfil, CF47 0UL. A site location plan is provided as Figure 2-1.



Figure 2-1 – site location

The proposals are for four new houses with a private drive to serve these and Plymouth House.

Based on the above, the risk of groundwater flooding is assessed to be low. Flooding from this source is not considered to be significant and has therefore not been considered further

3.1.4 Flooding from Sewers

There are no known instances of flooding from sewers in the area.

3.1.5 Flooding from Reservoirs, Canals and other Artificial Sources

Based upon Natural Resources Wales mapping, the site lies outside the area denoted as being at risk of flooding from a breach (failure) of a raised reservoir embankment, refer to Figure 3-2.

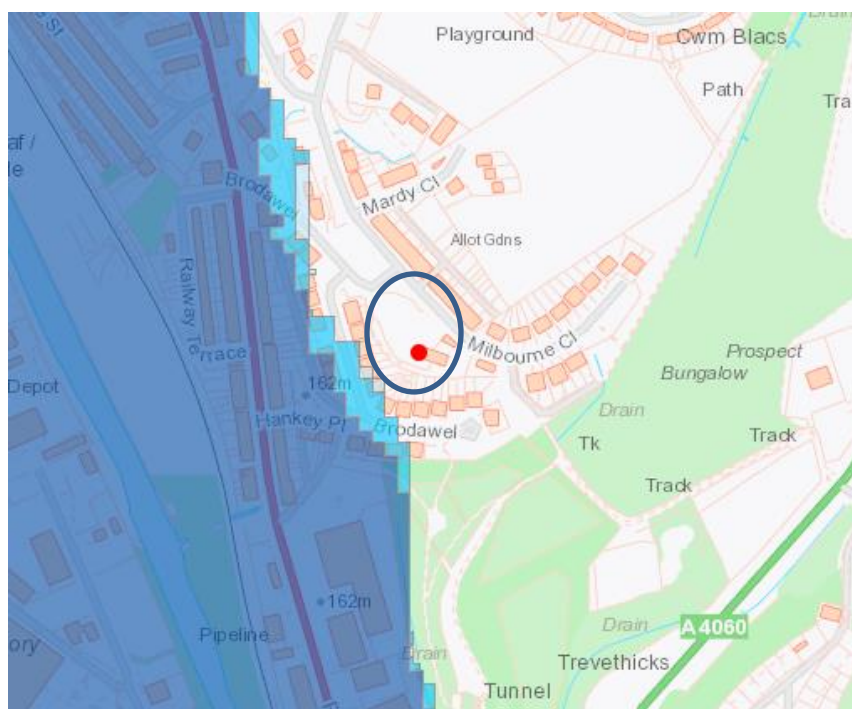


Figure 3-2 – Natural Resources Wales 'Risk of flooding from reservoir maps'

3.2 Flood Risk Summary

A summary of the potential sources of flooding and the flood risk arising from them is presented in Table 3-1

Potential Sources Of Flooding	Significant Flood Risk at the Site (Y/N)
Rivers or Fluvial Flooding	N
Sea or Tidal Flooding	N
Surface Water or Pluvial Flooding	N
Groundwater	N
Sewers	N
Reservoirs, Canals and other Artificial Sources	N

Table 3-1 – Summary of the Potential Sources of Flooding

Based on the screening study the, the site within Flood Zone A as described in Technical Advice Note 15: Development and Flood Risk (TAN15) - Considered to be at little or no risk of fluvial or tidal/coastal flooding.

4. Surface Water Drainage Strategy

4.1 Proposed Outline SuDS Strategy

The planning permission is subject to Flood and Water Management Act 2010 (Schedule 3) - The Sustainable Drainage (Approval and Adoption Procedure) (Wales) Regulations 2018 which came into force on 7th January 2019. The Act requires new developments to include Sustainable Drainage Systems (SuDS) features that comply with national standards.

4.2 Proposed Discharge Arrangement

With reference to Schedule 3 the hierarchy of preferred disposal options are as Standard 1 which are as follows:

Priority Level 1 – Surface water is collected for reuse

Priority Level 2 - Surface water is infiltrated to the ground

Priority Level 3 - Surface water runoff is discharged to a surface water body

Priority Level 4 - Surface water runoff is discharged to a surface water sewer, highway drain, or another drainage system

Priority Level 5 - Surface water runoff is discharged to a surface water combined sewer.

Table 4-1 summarises the suitability of the disposal methods in the context of the site and the proposed development.

Surface water disposal method	Suitability Description	Method Suitable? (Y/N)
Priority Level 1 - Collection for reuse.	The houses are for general sale and the use of a rainwater harvesting tank per development is not financially viable as there is no foreseeable demand.	N
Priority Level 2 - Infiltration to ground	The client has provided infiltration rates which are summarised in Table 4-2. The calculations are in Appendix A.	Y

Table 4-1 – Suitability of Surface Water Disposal Methods

	Pit 1	Pit 2	Pit 3	Pit 4	Pit 5
Infiltration Rate 1	2.63×10^{-5}	8.10×10^{-5}	2.07×10^{-4}	2.16×10^{-5}	3.20×10^{-5}
Infiltration Rate 2	1.50×10^{-5}	6.89×10^{-5}	1.78×10^{-4}	1.58×10^{-5}	1.59×10^{-5}
Infiltration Rate 3	1.14×10^{-5}	6.32×10^{-5}	1.94×10^{-4}	1.23×10^{-5}	1.43×10^{-5}

Table 4-2 – Infiltration Rates

The location of the infiltration tests can be found in Appendix A.

It is therefore proposed to comply with Standard S1 Level 2.

4.3 Proposed SuDS features

It is proposed to manage the surface water runoff from the development via the following interception mechanisms as summarised in Table 4-3.

SuDS Management Train Mechanism	Application	Potential Suitable Suds Features
Source Control	For the interception of surface water runoff at the source.	The surface water from the shared drive and private drive will be intercepted by the permeable paving.
Conveyance	To convey surface water runoff from 'Source Control' mechanisms to 'Site Control'.	The surface water from the shared drive and private drive will permeate through the sub base.
Site Control	Provides the required surface water attenuation prior to controlled discharge to ground.	The surface water from the shared drive and private drive will then dissipate to ground.

Table 4-3 Summary of Surface Water Management Strategy SuDS Options

4.4 Contributing Area

The existing driveway has a gulley to collect the surface water this will be removed as part of the development.

The impermeable areas are split as shown in Table 4-4

	Plot 1	Plot 2	Plot 3	Plot 4	Shared Drive
Drive (m ²)	33	29	26	30	170
Property & Patio (m ²)	107	107	107	109	-

Table 4-4 Impermeable Areas

The shared drive and the private drives have been designed as permeable and will discharge the surface water to the ground, refer to Appendix B for the calculations. The worst-case infiltration test from 1-3 was used for the design which is 1.14×10^{-5} m/s or 0.04m/hr.

The roof drainage discharges via an underground pipe to the bio retention area in the rear garden again the worst case infiltration test from 1-3 was used for the design which is 1.14×10^{-5} m/s or 0.04m/hr.

The Micro Drainage calculations are in Appendix B.

4.5 Water Quality

Standard S3 requires the design to minimise the potential pollution risk posed by the surface water to the receiving water body.

From Section 26 of The SuDS Manual the surface water runoff generated from the development has the pollution hazard levels as set out in Table 4-5

Land Use	Pollution Hazard Level	Pollution Hazard Indices		
		Total Suspended Solids (TSS)	Metals	Hydro-Carbons
Residential Roof	Low	0.2	0.2	0.05
Individual property drives and low traffic roads which as shared drives.	Low	0.5	0.4	0.4

Table 4-5 - Pollution Hazard Potential for Proposed Development

The Mitigation Indices are in Table 4-6.

Type of SuDS component	Mitigation Indices		
	Total Suspended Solids (TSS)	Metals	Hydro-Carbons
Bioretention system	0.8	0.8	0.8
Permeable paving	0.7	0.6	0.7

Table 4-6 - Mitigation Indices

The SuDS Mitigation Indices provided by the proposed 'Source Control', 'Conveyance' and 'Site Control' measures for a discharge to surface waters have been compared against the Pollution Hazard Indices.

The SuDS management train will consist of the following:

Discharge to bio retention areas. These areas will clean and filter out/absorb the pollutants and provide attenuation. Some of the run-off will also be lost in these areas due to up take by the vegetation and evaporating excess water into the atmosphere

The paving to the shared and individual drives are to be porous blocks to allow the water to be treated and stored in the sub-base prior to discharge to ground.

Refer to drawing IR20062/100P1 in Appendix C which further illustrates the drainage strategy for the development.

4.6 Amenity and Biodiversity

The drainage design has been carried out in conjunction with the Landscape plan – 712-01 - Planting Plan by Fiona Cloke to ensure the SuDS scheme makes the best contribution to the development by maximising the benefits for amenity as well as for biodiversity, water quantity and quality. The landscape plan is in Appendix D. The landscape plan was agreed at Planning prior the SAB design. Consultation with Fiona confirmed the plant mix specified for the area adjacent to the drive of Plot 4 is suitable for a bio retention area and will be specified for all four plots. The planting mix is at 4/m² and the number and type are specified in Table 5-5.

ID	Number	Latin Name	Scheduled Size
AjCG	8	Ajuga reptans `Catlin`s Giant`	CG, 2L
Am	6	Alchemilla mollis	10-20cm, CG, 2L
De Fern	8	Dryopteris erythrosora	30-40cm, CG, 2L
GR	6	Geranium 'Rozanne'	CG, 2L

Table 5-5 – Planting Mix

The proposed planting strategy seeks to enhance the landscape setting for this site and continue the green infrastructure for the location into the wider environment.

The proposed landscape design in co-ordination with the drainage proposals seeks to utilise bio-retention soils that will offer opportunities for a variety of plant species associated with wetter soils. This feature is on the edge of the site and will link to other soft landscape areas on and off the site to be able to benefit from a diverse planting mix and the benefits that will attract local wildlife.

The planting selection includes native species and species that provide flowers for insects and berries for birds.

5. Principal Operation and Maintenance Requirements.

All surface water drainage and pollution control features associated with the Site will remain private and will be maintained. To comply with Standard S6 the following sections outline recommended maintenance requirements for the various aspects of the drainage system for the development. If necessary, these outline operation and maintenance plan will be refined when the Site is operational to suit specific conditions.

5.1 Pervious Pavement

The permeable paving will be Tobermore paving or similar approved. The indicative maintenance costs of the permeable paving as supplied by Tobermore are £0.5 - £1 per m³ of storage volume.

Permeable paving lasts 20-25 years before requiring replacement of filter material. This is one of the longest lifespans of all SUDS options (Understanding permeable and impermeable surfaces, 2009, p.25).

Tobermore has advised that research has concluded that the infiltration capacity of a newly installed Hydropave Concrete Block pavement is over 4,000mm per hour. The bedding course and sub-base aggregates will have even higher infiltration capacity.

The UK guidelines require the infiltration rate of the surface joints to be 400mm and hour which is only 10% of the actual rate of newly installed permeable paving. Even allowing for clogging over the long term there is a large factor of safety built in.

The permeable paving loading category is 1-Domestic parking with zero standard (axles – refer to Figure 6.1) provided by Tobermore. Capping layers for domestic drives are generally not provided due to the low loadings. Permeable paving is only proposed on domestic drives (refer to drawing IR20062-100-P1 for details).

1 DOMESTIC PARKING	2 CAR	3 PEDESTRIAN	4 SHOPPING	5 COMMERCIAL	6 HEAVY TRAFFIC
No Large Goods Vehicles	Emergency Large Goods Vehicles only	One Large Goods Vehicle per week	Ten large Goods Vehicles per week	100 Large Goods Vehicles per week	1000 large Goods Vehicles per week
Zero standard axles	100 standard axles	0.015msa	0.15msa	1.5msa	15msa
Patio	Car parking bays and aisles	Town/city pedestrian street	Retail development delivery access route	Industrial premises	Main road
Private drive	Railway station platform	Nursery access	School/college access road	Lightly trafficked public road	Distribution centre
Decorative feature	External car showroom	Parking area to residential development	Office block delivery route	Light industrial development	Bus station (bus every 5 minutes)
Enclosed playground	Sports stadium pedestrian route	Garden centre external display area	Deliveries to small residential development	Mixed retail/ industrial development	Motorway Truck Stop
Footway with zero vehicle overrun	Footway with occasional overrun	Cemetery Crematorium	Garden centre delivery route	Town square	Bus stop
	Private drive/ footway crossover	Motel parking	Fire station yard	Footway with regular overrun	Roundabout
		Airport car park with no bus pickup	Airport car park with bus to terminal	Airport landside roads	Bus lane
		Sports centre	Sports stadium access route/ forecourt		

msa = millions of standard 8,000 kg axles.

Figure 5.1 – Loading Category from Tobermore.

Construction considerations

Sub-base material (coarse graded aggregate) should be placed in layers not exceeding 150mm in thickness or twice the nominal maximum aggregate size. Unlike traditional pavement construction, the open-graded materials should not be fully compacted to eliminate any voids, as this will compromise the performance of the system.

It is likely that excessive compaction will result in the displacement of the open graded aggregate by the compaction equipment. The open-graded material should be compacted such that its maximum density is achieved for the particular aggregate type and grading without compromising the final void percentage offered by the material.

Each layer should be suitably compacted before the next layer is placed to prevent any potential settlement of the pavement after completion.

Due to the nature of both the sub-layers and the block paving, care should be taken during the construction process to prevent dirt or detritus contaminating the sub-base and compromising the permeability of the system. For example, the trafficking of the sub-base as a site access route should not be undertaken. Should other construction or maintenance work take place close to the pavement which may affect the infiltration of the pavement, suitable protective measures should be implemented.

Edge restraints should be sufficiently robust to resist the lateral displacement from imposed loadings placed upon the pavement. The edge restraint may take the form of associated fittings, walls or buildings or be formed from precast concrete, clay or natural stone kerb systems, either existing or newly constructed features. The restraint must provide a consistent vertical face to a level below the laying course material.

Further site-specific requirements will be provided to the contractor once the order has been placed.

A recommended operation and maintenance plan for areas of pervious pavement is summarised in Table 5-1.

Maintenance Schedule	Required Action	Minimum Frequency
Routine visual inspections	In general, routine visual inspections are all that is required to determine whether or not remedial maintenance is required. Any infiltration issues are shown up by water ponding on the surface of the paving. If ponding is not visible, then remedial action is not required. If ponding is visible see section on Remedial Action for ponding. In the unlikely event that individual blocks are damaged these should be removed and replaced.	Once a year during or following heavy rainfall.
Regular Maintenance	Brushing with soapy water and a stiff brush will revive the colour of concrete block permeable paving. For a deeper clean of the block surface a pressure washer can be used to maintain the	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular

	appearance and colour of the paving blocks. A pressure washer set to a light / medium pressure should be all that is required to remove general dirt and grime. High pressure should not be used as this can damage the surface of the blocks. Tips: Hold the lance of the pressure washer at a 30 to 45-degree angle to the paved surface to avoid removal of the jointing material. After cleaning is finished, ensure that any jointing material which has been removed is top up with the correct material.	attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional Maintenance	Stabilise and mow contributing and adjacent areas.	As required
	Weeds tend not to establish in areas which receive regular trafficking by vehicles. If weeds are an issue, they can be dealt with by using a weed killer containing Glyphosate. The manufacturer's instructions should always be followed, and adequate Health & Safety measures should also be put in place when handling chemicals.	As required – once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50mm of the level of the paving	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to uses, and replace lost joining material.	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection.	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action.	Three-monthly, 48h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies.	Annually

Table 5-1 - Typical Pervious Pavement Operation and Maintenance Requirements

Guidelines to minimise maintenance and ensure the long-term performance of Hydropave Permeable Paving.

Pre- construction (Design stage)

It is essential that the system is designed correctly by a qualified engineer. Refer to BS 7533 Part 13

The design and detailing of the project should ensure that soil from soft landscaping is prevented from spilling onto the paving.

During construction.

It is essential that the paving is installed by an experienced contractor who is familiar with installing permeable paving and its components. Refer to BS7533 Part 3.

Mud / soil and other contaminants should be prevented from entering the sub-base, bedding course and jointing aggregates.

Do not allow muddy construction traffic to use the paved area once completed.

Do not allow soft landscaping to spill onto the paving surface

After construction.

Do not store materials which may clog up the permeable joints such as soil and mulch on top of the paving.

The joints between to permeable paving should be filled to the top with the correct aggregate.

5.2 Bioretention Area

The proposed drainage scheme will utilise a detention/bioretention area as a mechanism for collection, treatment and attenuation of surface water runoff. The anticipated maintenance and management for the detention basin associated with the surface water drainage system in outlined in Table 6-2

Maintenance Schedule	Required Action	Minimum Frequency
Regular maintenance	Remove litter (including leaf litter) and debris	Monthly (or as required)
	Cut grass to sides – to retain grass height within specified design range.	Monthly (during growing season) or as required.
	Manage other vegetation and remove nuisance plants.	Monthly at start then as required.
	Inspect inlets and outlets and overflows for blockages, and clear if required.	Monthly
	Inspect vegetation coverage.	Monthly for 6 months, quarterly for 2 years, the half yearly.
	Inspect inlet and facility surface for silt accumulation, establish appropriate silt removal frequencies.	Half Yearly
Occasional Maintenance	Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required.	As required or if bare soil is exposed over 10% or more of the treatment area.
Remedial Actions	Repair erosion or other damage by re-turfing or reseeding.	As required
	Remove and dispose of oils or petrol residues using safe standard practices.	As required

Table 5-2 Typical Detention Basin Operation & Maintenance Requirements

5.3 Underground Piped Systems

A recommend operation and maintenance plan for the piped drainage network is summarised in Table 5-3

Maintenance Schedule	Required Action	Minimum Frequency
Regular maintenance	Ensure drainage intakes are clear of debris/silt	Monthly (or as required)
Occasional Maintenance	Clear gully pots	6 monthly
	Jet clean sewer lines, gully tails and kerb channels to remove grease, grit, sediment and other debris to ensure conveyance capacity is not compromised	Every 2 years
	Clear perforated pipework of blockages	As required.
Intermittent Maintenance	CCTV survey of sewer lines to identify any defects/sign of performance degradation such as: Cracked/deteriorating pipes; Leaking joints/seals at manholes; High water line showing regular high stage in pipes (sign of lack of capacity or downstream constraint); and Suspected infiltration or exfiltration.	Every 2 – 5 years
Remedial Actions	Repair defects using suitable methods. Effective temporary repairs may be sufficient in short term until scheduled, capital improvements can be made.	As required
Monitoring	Record areas of surface ponding/intake bypassing/ surcharging (photos, inundated areas, depths) during extreme storm events and investigate the reasoning for this post-storm.	As required

Table 5-3 - Typical Pipe System Operation and Maintenance Requirements

Refer to the Landscape plan – 712-01 - Planting Plan by Fiona Cloke for the detailed landscaping maintenance in Appendix D.

6. Conclusions

Intrado has been appointed to develop a Surface Water Drainage Strategy to manage surface water runoff resulting from the construction the four plots.

The site is located in Flood Zone 1 and the potential sources of flood risk at the site have been confirmed with the conclusion that the flood risk to the site was predominantly very low and warrant no further consideration or specific mitigation measures to be applied.

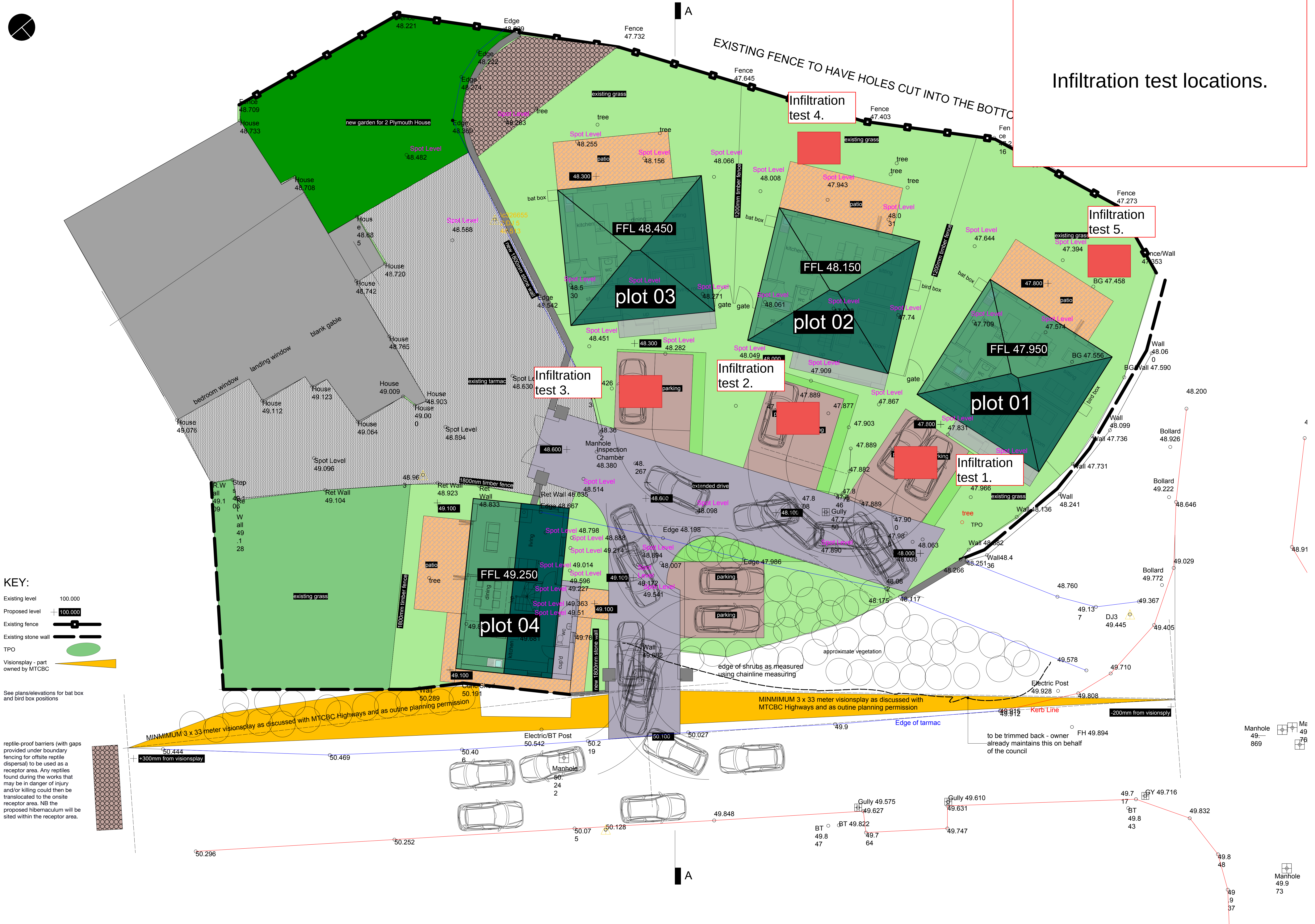
Technical information provided in this report on behalf of the Applicant seeks to demonstrate that a robust and sustainable drainage strategy has been prepared for the site, including residual events.

Residual flood events in excess of the design standard have also been considered, the drainage would be no worse than the current arrangement.

The surface water drainage strategy presented in this report demonstrates that adequate SuDS space provision is afforded within the development and that the proposed scheme is feasible and compliant to appropriate best practice and regulatory requirements and can be maintained in accordance with best practise. It is considered that the proposals ensure the safe management and maintenance of surface water runoff.

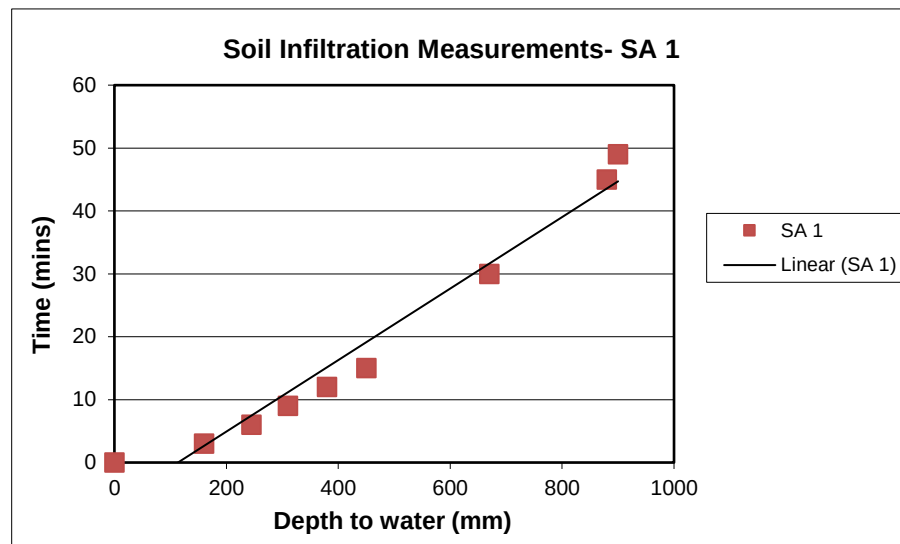
7. Appendix A

Infiltration Rates



Site Name: 2 Plymouth House development Merthyr Tydfil CF470UL
Date Undertaken: 18/05/2020
Trial Pit No.: 2
Fill No. 2

	Depth to Water (mm)	Time (Mins)
(effective depth - 100%)	0	0
	160	3
	245	6
	310	9
	380	12
	450	15
	670	30
	880	45
(effective depth - 0%)	900	49



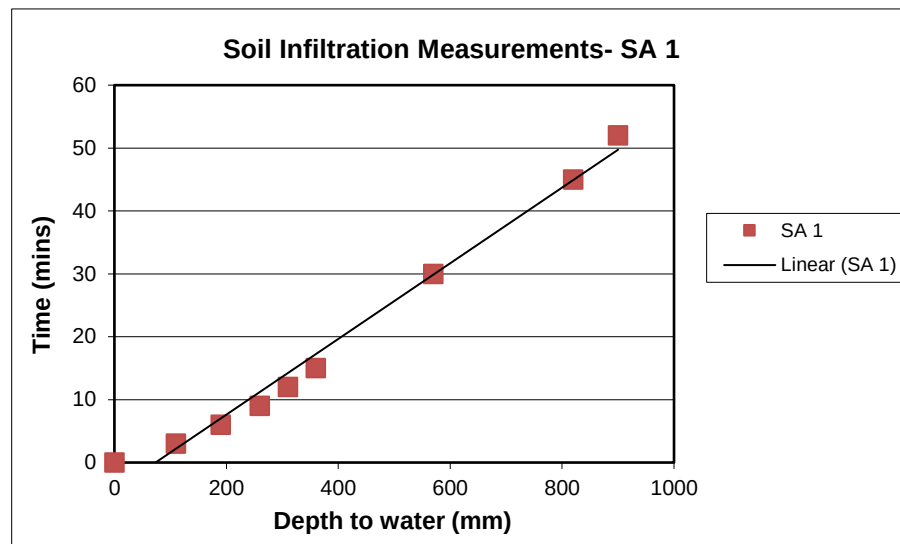
Length of Trial Pit (m)	1300.0
Width of Trial Pit (m)	900.0
Depth of Trial Pit (m)	900
Effective Storage Depth (m)	0.9
75% Effective Depth (Vp75)	0.225
25% Effective Depth (Vp25)	0.675
Volume of Water Outflowing (m3)	526500
Assumed 50% effective depth (ap50)	899.55
Mean Surface Area of outflow	5128020
Time for 25% Outflow (tp25)	6
Time for 75% Outflow (tp75)	32
Soil Infiltration Rate (m/s)	6.68867E-05

NB. tp25 and tp75 were calculated through a linear trend by fitting a straight line using the least squares method to the known values

Soil Infiltration Worksheet: This worksheet has been produced in combination with the document 'BRE Digest 365- September 1991'
 This worksheet can be used to determine soil infiltration rates from trial pit field measurements
 Worksheet options are identified by a shaded background

Site Name: 2 Plymouth House development Merthyr Tydfil CF470UL
Date Undertaken: 19/05/2020
Trial Pit No.: 2
Fill No. 3

	Depth to Water (mm)	Time (Mins)
(effective depth - 100%)	0	0
	110	3
	190	6
	260	9
	310	12
	360	15
	570	30
	820	45
(effective depth - 0%)	900	52



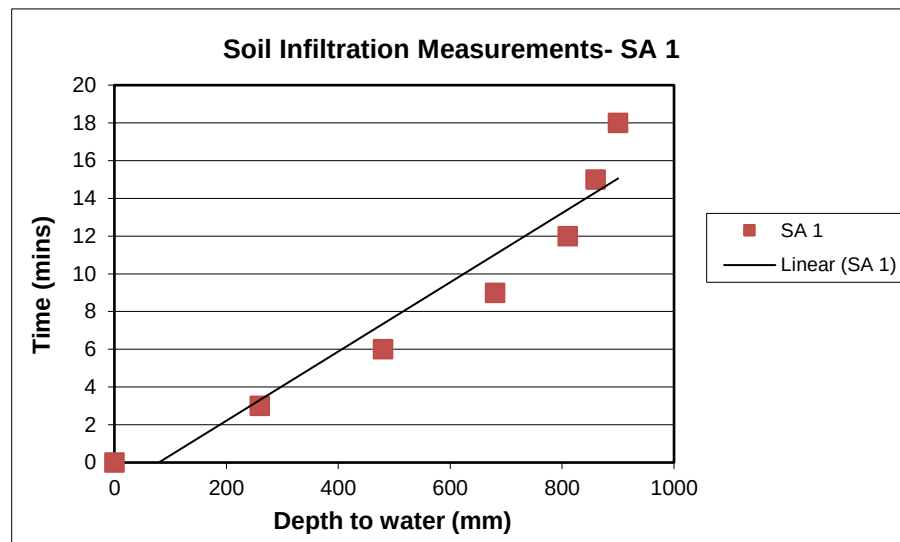
Length of Trial Pit (m)	1300.0
Width of Trial Pit (m)	900.0
Depth of Trial Pit (m)	900
Effective Storage Depth (m)	0.9
75% Effective Depth (Vp75)	0.225
25% Effective Depth (Vp25)	0.675
Volume of Water Outflowing (m3)	526500
Assumed 50% effective depth (ap50)	899.55
Mean Surface Area of outflow	5128020
Time for 25% Outflow (tp25)	9
Time for 75% Outflow (tp75)	36
Soil Infiltration Rate (m/s)	6.31951E-05

NB. tp25 and tp75 were calculated through a linear trend by fitting a straight line using the least squares method to the known values

Soil Infiltration Worksheet: This worksheet has been produced in combination with the document 'BRE Digest 365- September 1991'
 This worksheet can be used to determine soil infiltration rates from trial pit field measurements
 Worksheet options are identified by a shaded background

Site Name: 2 Plymouth House development Merthyr Tydfil CF470UL
Date Undertaken: 19/05/2020
Trial Pit No.: 3
Fill No. 1

	Depth to Water (mm)	Time (Mins)
(effective depth - 100%)	0	0
	260	3
	480	6
	680	9
	810	12
	860	15
(effective depth - 0%)	900	18



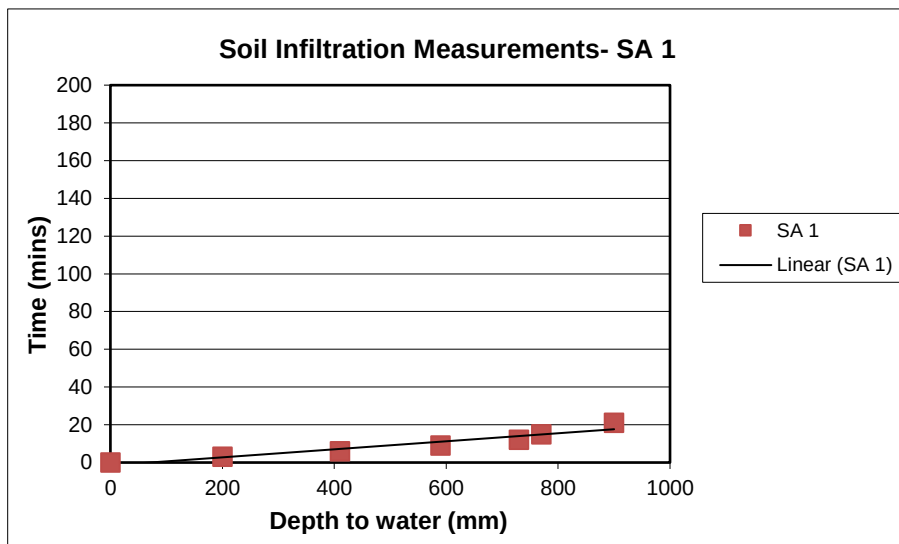
Length of Trial Pit (m)	1300.0
Width of Trial Pit (m)	900.0
Depth of Trial Pit (m)	900
Effective Storage Depth (m)	0.9
75% Effective Depth (Vp75)	0.225
25% Effective Depth (Vp25)	0.675
Volume of Water Outflowing (m3)	526500
Assumed 50% effective depth (ap50)	899.55
Mean Surface Area of outflow	5128020
Time for 25% Outflow (tp25)	3
Time for 75% Outflow (tp75)	11
Soil Infiltration Rate (m/s)	0.000207302

NB. tp25 and tp75 were calculated through a linear trend by fitting a straight line using the least squares method to the known values

Soil Infiltration Worksheet: This worksheet has been produced in combination with the document 'BRE Digest 365- September 1991'
 This worksheet can be used to determine soil infiltration rates from trial pit field measurements
 Worksheet options are identified by a shaded background

Site Name: 2 Plymouth House development Merthyr Tydfil CF470UL
Date Undertaken: 19/05/2020
Trial Pit No.: 3
Fill No. 2

	Depth to Water (mm)	Time (Mins)
(effective depth - 100%)	0	0
	200	3
	410	6
	590	9
	730	12
	770	15
(effective depth - 0%)	900	21
		45
		60
		75
		90
		120
		135
		150
		165
		180



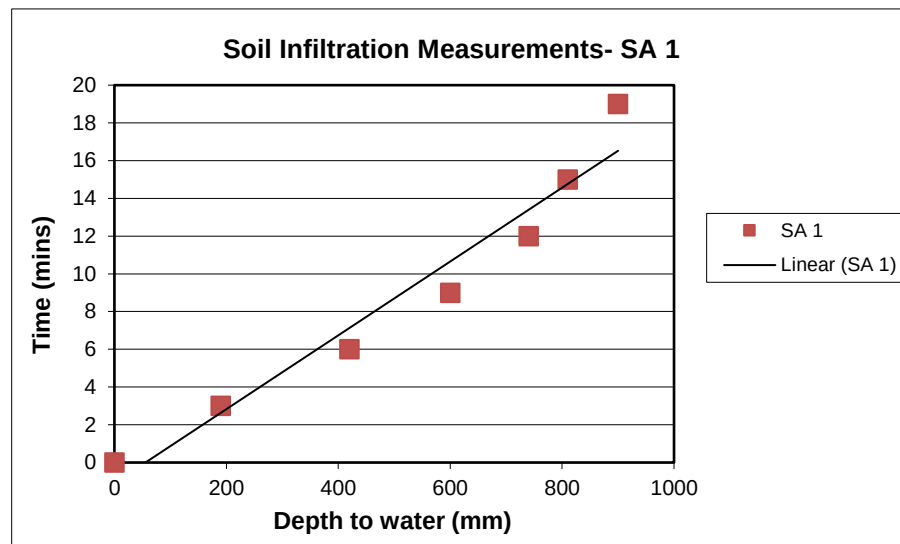
Length of Trial Pit (m)	1300.0
Width of Trial Pit (m)	900.0
Depth of Trial Pit (m)	900
Effective Storage Depth (m)	0.9
75% Effective Depth (Vp75)	0.225
25% Effective Depth (Vp25)	0.675
Volume of Water Outflowing (m3)	526500
Assumed 50% effective depth (ap50)	899.55
Mean Surface Area of outflow	5128020
Time for 25% Outflow (tp25)	3
Time for 75% Outflow (tp75)	13
Soil Infiltration Rate (m/s)	0.00017862

NB. tp25 and tp75 were calculated through a linear trend by fitting a straight line using the least squares method to the known values

Soil Infiltration Worksheet: This worksheet has been produced in combination with the document 'BRE Digest 365- September 1991'
 This worksheet can be used to determine soil infiltration rates from trial pit field measurements
 Worksheet options are identified by a shaded background

Site Name: 2 Plymouth House development Merthyr Tydfil CF470UL
Date Undertaken: 20/05/2020
Trial Pit No.: 3
Fill No. 3

	Depth to Water (mm)	Time (Mins)
(effective depth - 100%)	0	0
	190	3
	420	6
	600	9
	740	12
(effective depth - 0%)	810	15
19 mins	900	19



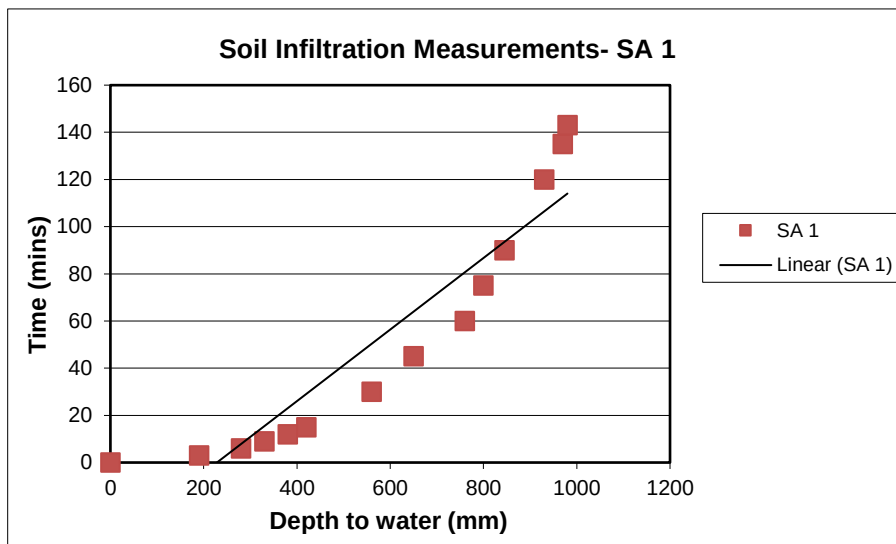
Length of Trial Pit (m)	1300.0
Width of Trial Pit (m)	900.0
Depth of Trial Pit (m)	900
Effective Storage Depth (m)	0.9
75% Effective Depth (Vp75)	0.225
25% Effective Depth (Vp25)	0.675
Volume of Water Outflowing (m3)	526500
Assumed 50% effective depth (ap50)	899.55
Mean Surface Area of outflow	5128020
Time for 25% Outflow (tp25)	3
Time for 75% Outflow (tp75)	12
Soil Infiltration Rate (m/s)	0.000194376

NB. tp25 and tp75 were calculated through a linear trend by fitting a straight line using the least squares method to the known values

Soil Infiltration Worksheet: This worksheet has been produced in combination with the document 'BRE Digest 365- September 1991'
 This worksheet can be used to determine soil infiltration rates from trial pit field measurements
 Worksheet options are identified by a shaded background

Site Name: 2 Plymouth House development Merthyr Tydfil CF470UL
Date Undertaken: 19/5/202
Trial Pit No.: 4
Fill No. 1

	Depth to Water (mm)	Time (Mins)
(effective depth - 100%)	0	0
	190	3
	280	6
	330	9
	380	12
	420	15
	560	30
	650	45
	760	60
	800	75
	845	90
	930	120
	970	135
(effective depth - 0%)	980	143



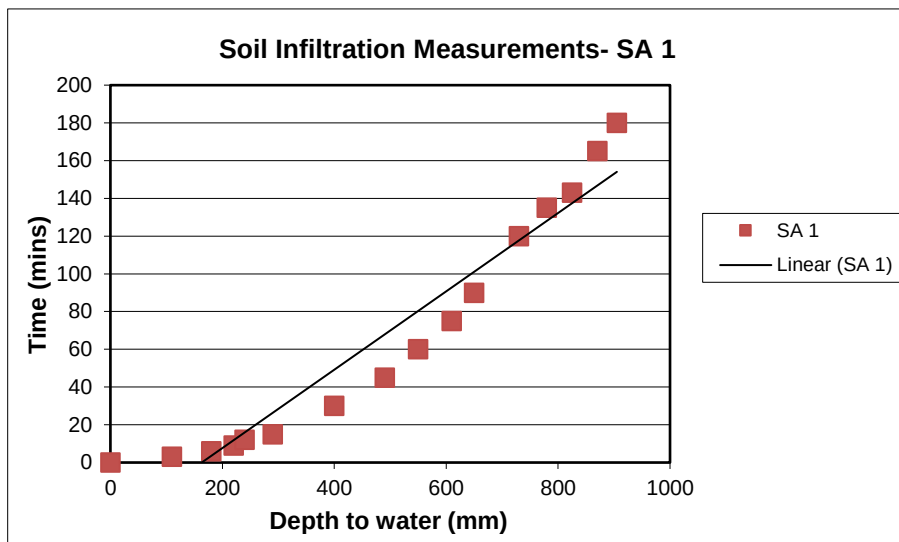
Length of Trial Pit (m)	1200.0
Width of Trial Pit (m)	800.0
Depth of Trial Pit (m)	980
Effective Storage Depth (m)	0.98
75% Effective Depth (Vp75)	0.245
25% Effective Depth (Vp25)	0.735
Volume of Water Outflowing (m3)	470400
Assumed 50% effective depth (ap50)	979.51
Mean Surface Area of outflow	4878040
Time for 25% Outflow (tp25)	3
Time for 75% Outflow (tp75)	77
Soil Infiltration Rate (m/s)	2.16185E-05

NB. tp25 and tp75 were calculated through a linear trend by fitting a straight line using the least squares method to the known values

Soil Infiltration Worksheet: This worksheet has been produced in combination with the document 'BRE Digest 365- September 1991'
 This worksheet can be used to determine soil infiltration rates from trial pit field measurements
 Worksheet options are identified by a shaded background

Site Name: 2 Plymouth House development Merthyr Tydfil CF470UL
Date Undertaken: 19/5/202
Trial Pit No.: 4
Fill No. 2

	Depth to Water (mm)	Time (Mins)
(effective depth - 100%)	0	0
	110	3
	180	6
	220	9
	240	12
	290	15
	400	30
	490	45
	550	60
	610	75
	650	90
	730	120
	780	135
	825	143
	870	165
(effective depth - 0%)	905	180



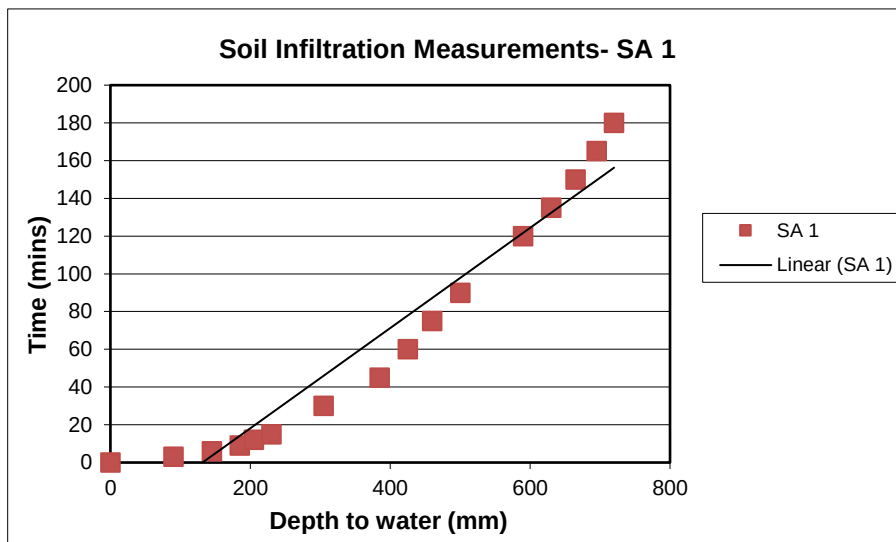
Length of Trial Pit (m)	1200.0
Width of Trial Pit (m)	800.0
Depth of Trial Pit (m)	980
Effective Storage Depth (m)	0.905
75% Effective Depth (Vp75)	0.22625
25% Effective Depth (Vp25)	0.67875
Volume of Water Outflowing (m3)	434400
Assumed 50% effective depth (ap50)	979.5475
Mean Surface Area of outflow	4878190
Time for 25% Outflow (tp25)	13
Time for 75% Outflow (tp75)	107
Soil Infiltration Rate (m/s)	1.57943E-05

NB. tp25 and tp75 were calculated through a linear trend by fitting a straight line using the least squares method to the known values

Soil Infiltration Worksheet: This worksheet has been produced in combination with the document 'BRE Digest 365- September 1991'
 This worksheet can be used to determine soil infiltration rates from trial pit field measurements
 Worksheet options are identified by a shaded background

Site Name: 2 Plymouth House development Merthyr Tydfil CF470UL
Date Undertaken: 20/01/1900
Trial Pit No.: 4
Fill No. 3

	Depth to Water (mm)	Time (Mins)
(effective depth - 100%)	0	0
	90	3
	145	6
	185	9
	205	12
	230	15
	305	30
	385	45
	425	60
	460	75
	500	90
	590	120
	630	135
	665	150
	695	165
(effective depth - 0%)	720	180



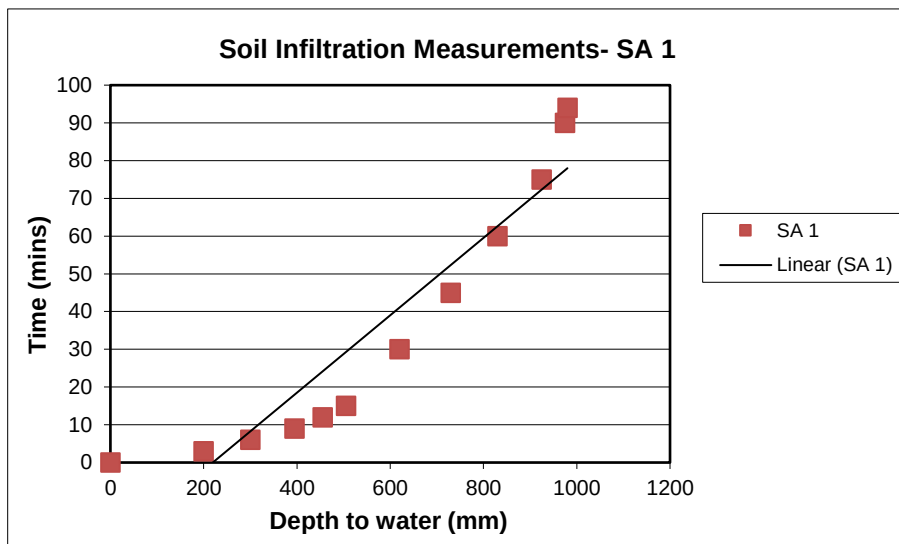
Length of Trial Pit (m)	1200.0
Width of Trial Pit (m)	800.0
Depth of Trial Pit (m)	980
Effective Storage Depth (m)	0.72
75% Effective Depth (Vp75)	0.18
25% Effective Depth (Vp25)	0.54
Volume of Water Outflowing (m3)	345600
Assumed 50% effective depth (ap50)	979.64
Mean Surface Area of outflow	4878560
Time for 25% Outflow (tp25)	13
Time for 75% Outflow (tp75)	108
Soil Infiltration Rate (m/s)	1.23481E-05

NB. tp25 and tp75 were calculated through a linear trend by fitting a straight line using the least squares method to the known values

Soil Infiltration Worksheet: This worksheet has been produced in combination with the document 'BRE Digest 365- September 1991'
 This worksheet can be used to determine soil infiltration rates from trial pit field measurements
 Worksheet options are identified by a shaded background

Site Name: 2 Plymouth House development Merthyr Tydfil CF470UL
Date Undertaken: 19/5/202
Trial Pit No.: 5
Fill No. 1

	Depth to Water (mm)	Time (Mins)
(effective depth - 100%)	0	0
	200	3
	300	6
	395	9
	455	12
	505	15
	620	30
	730	45
	830	60
	925	75
	975	90
(effective depth - 0%)	980	94



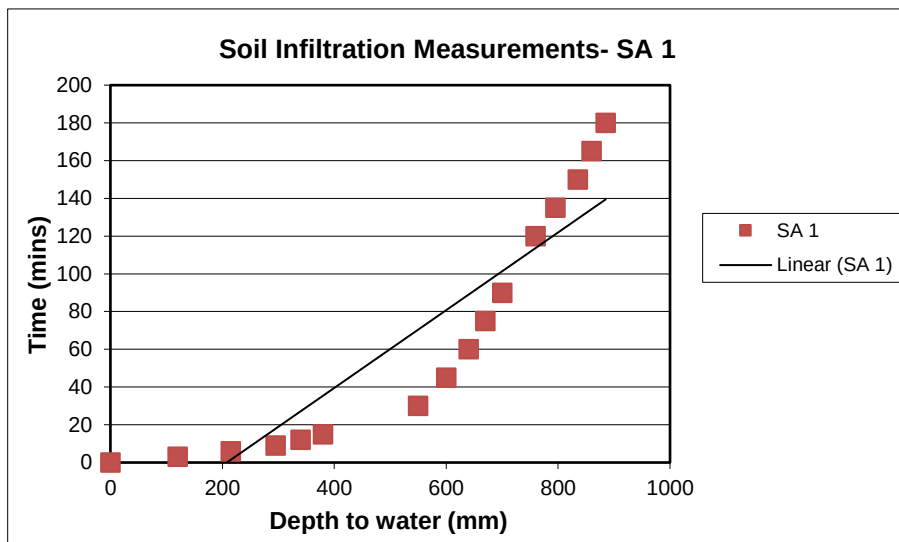
Length of Trial Pit (m)	1200.0
Width of Trial Pit (m)	800.0
Depth of Trial Pit (m)	980
Effective Storage Depth (m)	0.98
75% Effective Depth (Vp75)	0.245
25% Effective Depth (Vp25)	0.735
Volume of Water Outflowing (m3)	470400
Assumed 50% effective depth (ap50)	979.51
Mean Surface Area of outflow	4878040
Time for 25% Outflow (tp25)	3
Time for 75% Outflow (tp75)	53
Soil Infiltration Rate (m/s)	3.19849E-05

NB. tp25 and tp75 were calculated through a linear trend by fitting a straight line using the least squares method to the known values

Soil Infiltration Worksheet: This worksheet has been produced in combination with the document 'BRE Digest 365- September 1991'
 This worksheet can be used to determine soil infiltration rates from trial pit field measurements
 Worksheet options are identified by a shaded background

Site Name: 2 Plymouth House development Merthyr Tydfil CF470UL
Date Undertaken: 19/5/202
Trial Pit No.: 5
Fill No. 2

	Depth to Water (mm)	Time (Mins)
(effective depth - 100%)	0	0
	120	3
	215	6
	295	9
	340	12
	380	15
	550	30
	600	45
	640	60
	670	75
	700	90
	760	120
	795	135
	835	150
	860	165
(effective depth - 0%)	885	180



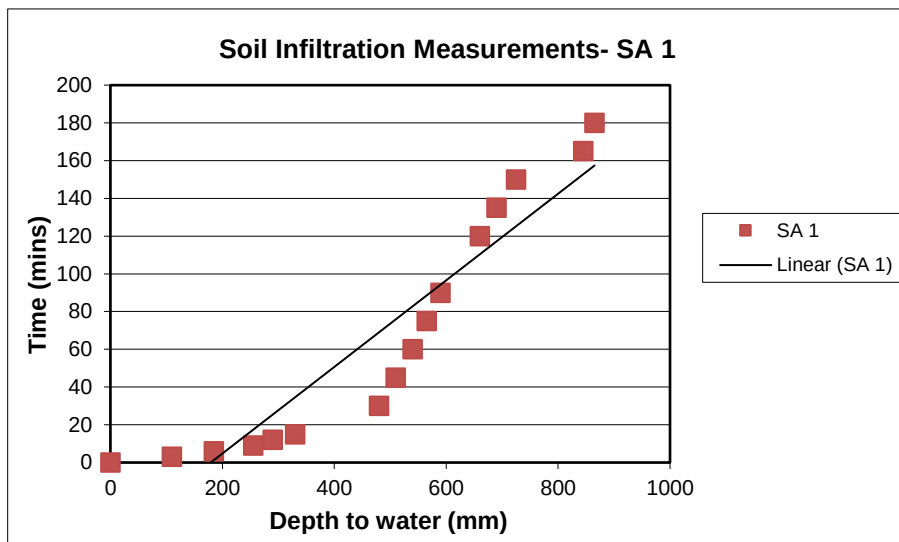
Length of Trial Pit (m)	1200.0
Width of Trial Pit (m)	800.0
Depth of Trial Pit (m)	980
Effective Storage Depth (m)	0.885
75% Effective Depth (Vp75)	0.22125
25% Effective Depth (Vp25)	0.66375
Volume of Water Outflowing (m3)	424800
Assumed 50% effective depth (ap50)	979.5575
Mean Surface Area of outflow	4878230
Time for 25% Outflow (tp25)	3
Time for 75% Outflow (tp75)	94
Soil Infiltration Rate (m/s)	1.59192E-05

NB. tp25 and tp75 were calculated through a linear trend by fitting a straight line using the least squares method to the known values

Soil Infiltration Worksheet: This worksheet has been produced in combination with the document 'BRE Digest 365- September 1991'
 This worksheet can be used to determine soil infiltration rates from trial pit field measurements
 Worksheet options are identified by a shaded background

Site Name: 2 Plymouth House development Merthyr Tydfil CF470UL
Date Undertaken: 20/5/202
Trial Pit No.: 5
Fill No. 3

	Depth to Water (mm)	Time (Mins)
(effective depth - 100%)	0	0
	110	3
	185	6
	255	9
	290	12
	330	15
	480	30
	510	45
	540	60
	565	75
	590	90
	660	120
	690	135
	725	150
	845	165
(effective depth - 0%)	865	180



Length of Trial Pit (m)	1200.0
Width of Trial Pit (m)	800.0
Depth of Trial Pit (m)	980
Effective Storage Depth (m)	0.865
75% Effective Depth (Vp75)	0.21625
25% Effective Depth (Vp25)	0.64875
Volume of Water Outflowing (m3)	415200
Assumed 50% effective depth (ap50)	979.5675
Mean Surface Area of outflow	4878270
Time for 25% Outflow (tp25)	8
Time for 75% Outflow (tp75)	108
Soil Infiltration Rate (m/s)	1.42883E-05

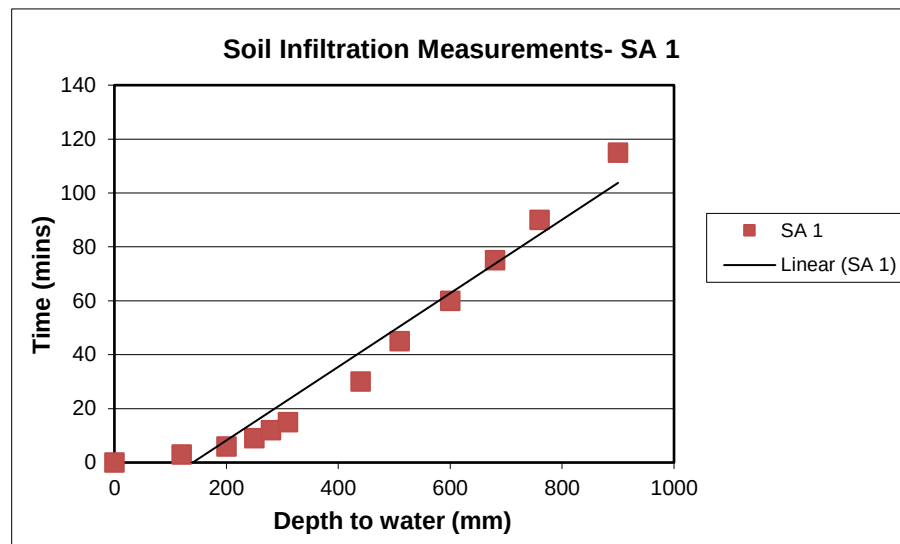
NB. tp25 and tp75 were calculated through a linear trend by fitting a straight line using the least squares method to the known values

Soil Infiltration Worksheet: This worksheet has been produced in combination with the document 'BRE Digest 365- September 1991'
 This worksheet can be used to determine soil infiltration rates from trial pit field measurements
 Worksheet options are identified by a shaded background

Site Name: 2 Plymouth House development Merthyr Tydfil CF470UL
Date Undertaken: 18/05/2020
Trial Pit No.: 1
Fill No. 1

	Depth to Water (mm)	Time (Mins)
(effective depth - 100%)	0	0
	120	3
	200	6
	250	9
	280	12
	310	15
	440	30
	510	45
	600	60
	680	75
	760	90
(effective depth - 0%)	900	115

Length of Trial Pit (m)	1300.0
Width of Trial Pit (m)	800.0
Depth of Trial Pit (m)	900
Effective Storage Depth (m)	0.9
75% Effective Depth (Vp75)	-0.675
25% Effective Depth (Vp25)	-0.225
Volume of Water Outflowing (m3)	468000
Assumed 50% effective depth (ap50)	900.45
Mean Surface Area of outflow	4821890
Time for 25% Outflow (tp25)	-111
Time for 75% Outflow (tp75)	-50
Soil Infiltration Rate (m/s)	2.63334E-05

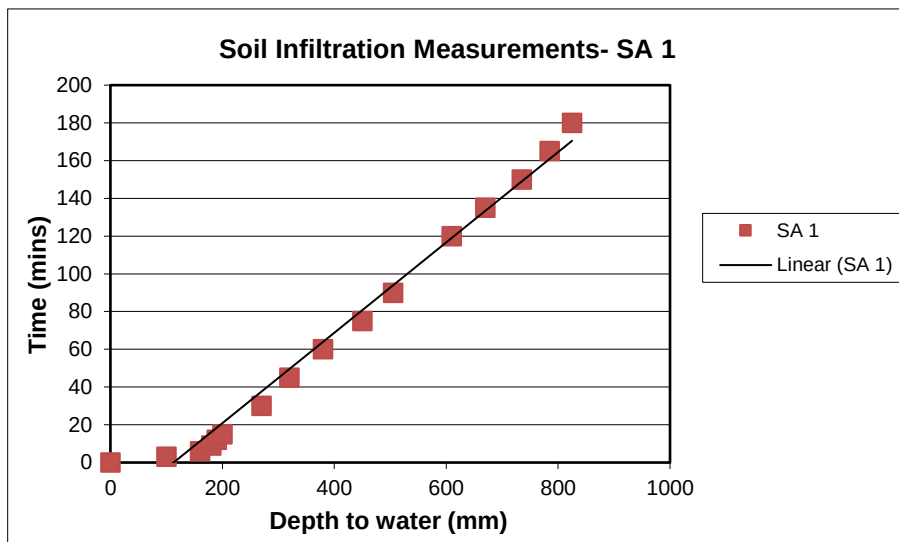


NB. tp25 and tp75 were calculated through a linear trend by fitting a straight line using the least squares method to the known values

Soil Infiltration Worksheet: This worksheet has been produced in combination with the document 'BRE Digest 365- September 1991'
 This worksheet can be used to determine soil infiltration rates from trial pit field measurements
 Worksheet options are identified by a shaded background

Site Name: 2 Plymouth House development Merthyr Tydfil CF470UL
Date Undertaken: 18/05/2020
Trial Pit No.: 1
Fill No. 2

	Depth to Water (mm)	Time (Mins)
(effective depth - 100%)	0	0
	100	3
	160	6
	180	9
	190	12
	200	15
	270	30
	320	45
	380	60
	450	75
	505	90
	610	120
	670	135
	735	150
	785	165
(effective depth - 0%)	825	180



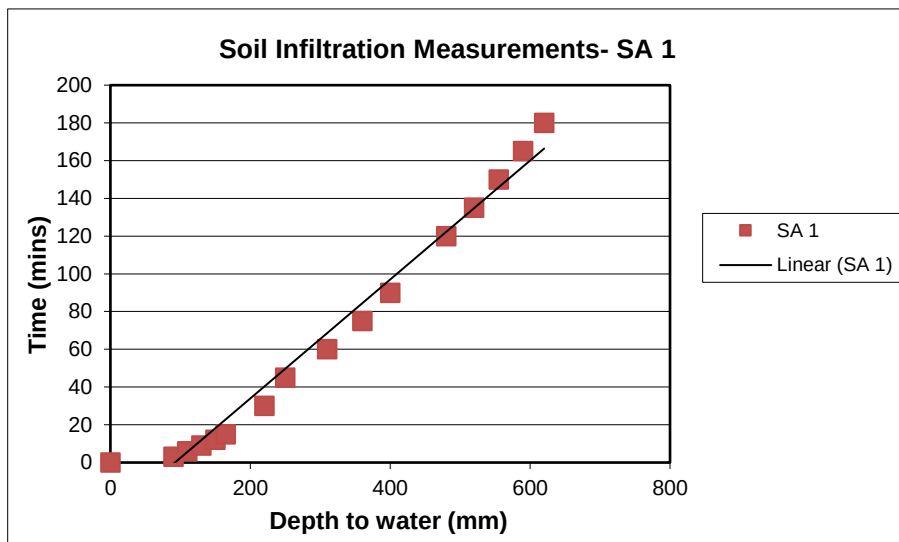
Length of Trial Pit (m)	1300.0
Width of Trial Pit (m)	800.0
Depth of Trial Pit (m)	900
Effective Storage Depth (m)	0.825
75% Effective Depth (Vp75)	0.20625
25% Effective Depth (Vp25)	0.61875
Volume of Water Outflowing (m3)	429000
Assumed 50% effective depth (ap50)	899.5875
Mean Surface Area of outflow	4818267.5
Time for 25% Outflow (tp25)	22
Time for 75% Outflow (tp75)	121
Soil Infiltration Rate (m/s)	1.50217E-05

NB. tp25 and tp75 were calculated through a linear trend by fitting a straight line using the least squares method to the known values

Soil Infiltration Worksheet: This worksheet has been produced in combination with the document 'BRE Digest 365- September 1991'
 This worksheet can be used to determine soil infiltration rates from trial pit field measurements
 Worksheet options are identified by a shaded background

Site Name: 2 Plymouth House development Merthyr Tydfil CF470UL
Date Undertaken: 19/05/2020
Trial Pit No.: 1
Fill No. 3

	Depth to Water (mm)	Time (Mins)
(effective depth - 100%)	0	0
	90	3
	110	6
	130	9
	150	12
	165	15
	220	30
	250	45
	310	60
	360	75
	400	90
	480	120
	520	135
	555	150
	590	165
(effective depth - 0%)	620	180



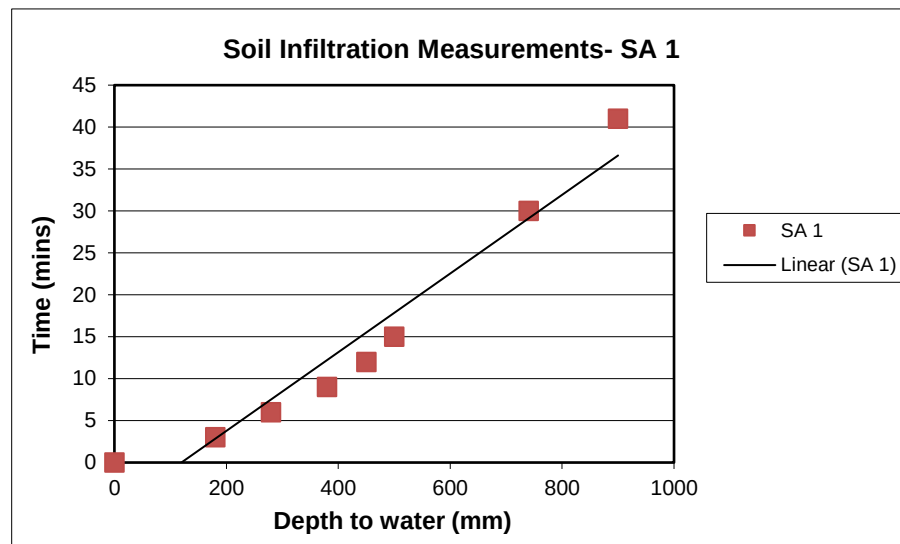
Length of Trial Pit (m)	1300.0
Width of Trial Pit (m)	800.0
Depth of Trial Pit (m)	900
Effective Storage Depth (m)	0.62
75% Effective Depth (Vp75)	0.155
25% Effective Depth (Vp25)	0.465
Volume of Water Outflowing (m3)	322400
Assumed 50% effective depth (ap50)	899.69
Mean Surface Area of outflow	4818698
Time for 25% Outflow (tp25)	20
Time for 75% Outflow (tp75)	118
Soil Infiltration Rate (m/s)	1.14098E-05

NB. tp25 and tp75 were calculated through a linear trend by fitting a straight line using the least squares method to the known values

Soil Infiltration Worksheet: This worksheet has been produced in combination with the document 'BRE Digest 365- September 1991'
 This worksheet can be used to determine soil infiltration rates from trial pit field measurements
 Worksheet options are identified by a shaded background

Site Name: 2 Plymouth House development Merthyr Tydfil CF470UL
Date Undertaken: 18/05/2020
Trial Pit No.: 2
Fill No. 1

	Depth to Water (mm)	Time (Mins)
(effective depth - 100%)	0	0
	180	3
	280	6
	380	9
	450	12
	500	15
	740	30
(effective depth - 0%)	900	41



Length of Trial Pit (m)	1300.0
Width of Trial Pit (m)	900.0
Depth of Trial Pit (m)	900
Effective Storage Depth (m)	0.9
75% Effective Depth (Vp75)	0.225
25% Effective Depth (Vp25)	0.675
Volume of Water Outflowing (m3)	526500
Assumed 50% effective depth (ap50)	899.55
Mean Surface Area of outflow	5128020
Time for 25% Outflow (tp25)	5
Time for 75% Outflow (tp75)	26
Soil Infiltration Rate (m/s)	8.10386E-05

NB. tp25 and tp75 were calculated through a linear trend by fitting a straight line using the least squares method to the known values

Soil Infiltration Worksheet: This worksheet has been produced in combination with the document 'BRE Digest 365- September 1991'
 This worksheet can be used to determine soil infiltration rates from trial pit field measurements
 Worksheet options are identified by a shaded background

8. Appendix B

Microdrainage Calculations

INTRADO				Page 1																																																																																																																																																																																																																			
Castle House 63-69 Cardiff Road CF15 7RD		IR20062 Plymouth House Individual Drives																																																																																																																																																																																																																					
Date 18/06/2020 17:42 File Individual drive.SRCX		Designed by Clare Checked by																																																																																																																																																																																																																					
XP Solutions		Source Control 2018.1.1																																																																																																																																																																																																																					
Summary of Results for 100 year Return Period (+30%) Half Drain Time : 67 minutes. <table><thead><tr><th>Storm Event</th><th>Max Level (m)</th><th>Max Depth (m)</th><th>Max Infiltration (l/s)</th><th>Max Volume (m³)</th><th>Status</th></tr></thead><tbody><tr><td>15 min Summer</td><td>47.577</td><td>0.057</td><td>0.1</td><td>0.4</td><td>O K</td></tr><tr><td>30 min Summer</td><td>47.604</td><td>0.084</td><td>0.1</td><td>0.6</td><td>O K</td></tr><tr><td>60 min Summer</td><td>47.631</td><td>0.111</td><td>0.1</td><td>0.8</td><td>O K</td></tr><tr><td>120 min Summer</td><td>47.644</td><td>0.124</td><td>0.1</td><td>0.9</td><td>O K</td></tr><tr><td>180 min Summer</td><td>47.648</td><td>0.128</td><td>0.1</td><td>1.0</td><td>O K</td></tr><tr><td>240 min Summer</td><td>47.648</td><td>0.128</td><td>0.1</td><td>1.0</td><td>O K</td></tr><tr><td>360 min Summer</td><td>47.642</td><td>0.122</td><td>0.1</td><td>0.9</td><td>O K</td></tr><tr><td>480 min Summer</td><td>47.633</td><td>0.113</td><td>0.1</td><td>0.8</td><td>O K</td></tr><tr><td>600 min Summer</td><td>47.624</td><td>0.104</td><td>0.1</td><td>0.8</td><td>O K</td></tr><tr><td>720 min Summer</td><td>47.614</td><td>0.094</td><td>0.1</td><td>0.7</td><td>O K</td></tr><tr><td>960 min Summer</td><td>47.597</td><td>0.077</td><td>0.1</td><td>0.6</td><td>O K</td></tr><tr><td>1440 min Summer</td><td>47.573</td><td>0.053</td><td>0.1</td><td>0.4</td><td>O K</td></tr><tr><td>2160 min Summer</td><td>47.562</td><td>0.042</td><td>0.1</td><td>0.3</td><td>O K</td></tr><tr><td>2880 min Summer</td><td>47.556</td><td>0.036</td><td>0.1</td><td>0.2</td><td>O K</td></tr><tr><td>4320 min Summer</td><td>47.548</td><td>0.028</td><td>0.1</td><td>0.2</td><td>O K</td></tr><tr><td>5760 min Summer</td><td>47.544</td><td>0.024</td><td>0.1</td><td>0.1</td><td>O K</td></tr><tr><td>7200 min Summer</td><td>47.541</td><td>0.021</td><td>0.1</td><td>0.1</td><td>O K</td></tr><tr><td>8640 min Summer</td><td>47.539</td><td>0.019</td><td>0.1</td><td>0.1</td><td>O K</td></tr><tr><td>10080 min Summer</td><td>47.538</td><td>0.018</td><td>0.1</td><td>0.1</td><td>O K</td></tr><tr><td>15 min Winter</td><td>47.587</td><td>0.067</td><td>0.1</td><td>0.5</td><td>O K</td></tr></tbody></table> <table><thead><tr><th>Storm Event</th><th>Rain (mm/hr)</th><th>Flooded Volume (m³)</th><th>Time-Peak (mins)</th></tr></thead><tbody><tr><td>15 min Summer</td><td>107.640</td><td>0.0</td><td>17</td></tr><tr><td>30 min Summer</td><td>79.560</td><td>0.0</td><td>31</td></tr><tr><td>60 min Summer</td><td>56.160</td><td>0.0</td><td>52</td></tr><tr><td>120 min Summer</td><td>35.945</td><td>0.0</td><td>86</td></tr><tr><td>180 min Summer</td><td>27.800</td><td>0.0</td><td>122</td></tr><tr><td>240 min Summer</td><td>23.173</td><td>0.0</td><td>156</td></tr><tr><td>360 min Summer</td><td>17.875</td><td>0.0</td><td>226</td></tr><tr><td>480 min Summer</td><td>14.810</td><td>0.0</td><td>290</td></tr><tr><td>600 min Summer</td><td>12.775</td><td>0.0</td><td>356</td></tr><tr><td>720 min Summer</td><td>11.310</td><td>0.0</td><td>418</td></tr><tr><td>960 min Summer</td><td>9.316</td><td>0.0</td><td>538</td></tr><tr><td>1440 min Summer</td><td>7.080</td><td>0.0</td><td>762</td></tr><tr><td>2160 min Summer</td><td>5.366</td><td>0.0</td><td>1108</td></tr><tr><td>2880 min Summer</td><td>4.423</td><td>0.0</td><td>1472</td></tr><tr><td>4320 min Summer</td><td>3.404</td><td>0.0</td><td>2204</td></tr><tr><td>5760 min Summer</td><td>2.860</td><td>0.0</td><td>2936</td></tr><tr><td>7200 min Summer</td><td>2.528</td><td>0.0</td><td>3640</td></tr><tr><td>8640 min Summer</td><td>2.303</td><td>0.0</td><td>4400</td></tr><tr><td>10080 min Summer</td><td>2.142</td><td>0.0</td><td>5136</td></tr><tr><td>15 min Winter</td><td>107.640</td><td>0.0</td><td>17</td></tr></tbody></table>						Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status	15 min Summer	47.577	0.057	0.1	0.4	O K	30 min Summer	47.604	0.084	0.1	0.6	O K	60 min Summer	47.631	0.111	0.1	0.8	O K	120 min Summer	47.644	0.124	0.1	0.9	O K	180 min Summer	47.648	0.128	0.1	1.0	O K	240 min Summer	47.648	0.128	0.1	1.0	O K	360 min Summer	47.642	0.122	0.1	0.9	O K	480 min Summer	47.633	0.113	0.1	0.8	O K	600 min Summer	47.624	0.104	0.1	0.8	O K	720 min Summer	47.614	0.094	0.1	0.7	O K	960 min Summer	47.597	0.077	0.1	0.6	O K	1440 min Summer	47.573	0.053	0.1	0.4	O K	2160 min Summer	47.562	0.042	0.1	0.3	O K	2880 min Summer	47.556	0.036	0.1	0.2	O K	4320 min Summer	47.548	0.028	0.1	0.2	O K	5760 min Summer	47.544	0.024	0.1	0.1	O K	7200 min Summer	47.541	0.021	0.1	0.1	O K	8640 min Summer	47.539	0.019	0.1	0.1	O K	10080 min Summer	47.538	0.018	0.1	0.1	O K	15 min Winter	47.587	0.067	0.1	0.5	O K	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)	15 min Summer	107.640	0.0	17	30 min Summer	79.560	0.0	31	60 min Summer	56.160	0.0	52	120 min Summer	35.945	0.0	86	180 min Summer	27.800	0.0	122	240 min Summer	23.173	0.0	156	360 min Summer	17.875	0.0	226	480 min Summer	14.810	0.0	290	600 min Summer	12.775	0.0	356	720 min Summer	11.310	0.0	418	960 min Summer	9.316	0.0	538	1440 min Summer	7.080	0.0	762	2160 min Summer	5.366	0.0	1108	2880 min Summer	4.423	0.0	1472	4320 min Summer	3.404	0.0	2204	5760 min Summer	2.860	0.0	2936	7200 min Summer	2.528	0.0	3640	8640 min Summer	2.303	0.0	4400	10080 min Summer	2.142	0.0	5136	15 min Winter	107.640	0.0	17
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status																																																																																																																																																																																																																		
15 min Summer	47.577	0.057	0.1	0.4	O K																																																																																																																																																																																																																		
30 min Summer	47.604	0.084	0.1	0.6	O K																																																																																																																																																																																																																		
60 min Summer	47.631	0.111	0.1	0.8	O K																																																																																																																																																																																																																		
120 min Summer	47.644	0.124	0.1	0.9	O K																																																																																																																																																																																																																		
180 min Summer	47.648	0.128	0.1	1.0	O K																																																																																																																																																																																																																		
240 min Summer	47.648	0.128	0.1	1.0	O K																																																																																																																																																																																																																		
360 min Summer	47.642	0.122	0.1	0.9	O K																																																																																																																																																																																																																		
480 min Summer	47.633	0.113	0.1	0.8	O K																																																																																																																																																																																																																		
600 min Summer	47.624	0.104	0.1	0.8	O K																																																																																																																																																																																																																		
720 min Summer	47.614	0.094	0.1	0.7	O K																																																																																																																																																																																																																		
960 min Summer	47.597	0.077	0.1	0.6	O K																																																																																																																																																																																																																		
1440 min Summer	47.573	0.053	0.1	0.4	O K																																																																																																																																																																																																																		
2160 min Summer	47.562	0.042	0.1	0.3	O K																																																																																																																																																																																																																		
2880 min Summer	47.556	0.036	0.1	0.2	O K																																																																																																																																																																																																																		
4320 min Summer	47.548	0.028	0.1	0.2	O K																																																																																																																																																																																																																		
5760 min Summer	47.544	0.024	0.1	0.1	O K																																																																																																																																																																																																																		
7200 min Summer	47.541	0.021	0.1	0.1	O K																																																																																																																																																																																																																		
8640 min Summer	47.539	0.019	0.1	0.1	O K																																																																																																																																																																																																																		
10080 min Summer	47.538	0.018	0.1	0.1	O K																																																																																																																																																																																																																		
15 min Winter	47.587	0.067	0.1	0.5	O K																																																																																																																																																																																																																		
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)																																																																																																																																																																																																																				
15 min Summer	107.640	0.0	17																																																																																																																																																																																																																				
30 min Summer	79.560	0.0	31																																																																																																																																																																																																																				
60 min Summer	56.160	0.0	52																																																																																																																																																																																																																				
120 min Summer	35.945	0.0	86																																																																																																																																																																																																																				
180 min Summer	27.800	0.0	122																																																																																																																																																																																																																				
240 min Summer	23.173	0.0	156																																																																																																																																																																																																																				
360 min Summer	17.875	0.0	226																																																																																																																																																																																																																				
480 min Summer	14.810	0.0	290																																																																																																																																																																																																																				
600 min Summer	12.775	0.0	356																																																																																																																																																																																																																				
720 min Summer	11.310	0.0	418																																																																																																																																																																																																																				
960 min Summer	9.316	0.0	538																																																																																																																																																																																																																				
1440 min Summer	7.080	0.0	762																																																																																																																																																																																																																				
2160 min Summer	5.366	0.0	1108																																																																																																																																																																																																																				
2880 min Summer	4.423	0.0	1472																																																																																																																																																																																																																				
4320 min Summer	3.404	0.0	2204																																																																																																																																																																																																																				
5760 min Summer	2.860	0.0	2936																																																																																																																																																																																																																				
7200 min Summer	2.528	0.0	3640																																																																																																																																																																																																																				
8640 min Summer	2.303	0.0	4400																																																																																																																																																																																																																				
10080 min Summer	2.142	0.0	5136																																																																																																																																																																																																																				
15 min Winter	107.640	0.0	17																																																																																																																																																																																																																				
©1982-2018 Innovyze																																																																																																																																																																																																																							

INTRADO				Page 2	
Castle House 63-69 Cardiff Road CF15 7RD		IR20062 Plymouth House Individual Drives			
Date 18/06/2020 17:42 File Individual drive.SRCX		Designed by Clare Checked by			
XP Solutions		Source Control 2018.1.1			
<u>Summary of Results for 100 year Return Period (+30%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	47.619	0.099	0.1	0.7	O K
60 min Winter	47.650	0.130	0.1	1.0	O K
120 min Winter	47.663	0.143	0.1	1.1	O K
180 min Winter	47.665	0.145	0.1	1.1	O K
240 min Winter	47.663	0.143	0.1	1.1	O K
360 min Winter	47.650	0.130	0.1	1.0	O K
480 min Winter	47.634	0.114	0.1	0.8	O K
600 min Winter	47.617	0.097	0.1	0.7	O K
720 min Winter	47.602	0.082	0.1	0.6	O K
960 min Winter	47.577	0.057	0.1	0.4	O K
1440 min Winter	47.562	0.042	0.1	0.3	O K
2160 min Winter	47.553	0.033	0.1	0.2	O K
2880 min Winter	47.547	0.027	0.1	0.2	O K
4320 min Winter	47.541	0.021	0.1	0.1	O K
5760 min Winter	47.538	0.018	0.1	0.1	O K
7200 min Winter	47.536	0.016	0.0	0.1	O K
8640 min Winter	47.534	0.014	0.0	0.1	O K
10080 min Winter	47.533	0.013	0.0	0.1	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)		
30 min Winter	79.560	0.0	31		
60 min Winter	56.160	0.0	58		
120 min Winter	35.945	0.0	94		
180 min Winter	27.800	0.0	134		
240 min Winter	23.173	0.0	172		
360 min Winter	17.875	0.0	244		
480 min Winter	14.810	0.0	312		
600 min Winter	12.775	0.0	376		
720 min Winter	11.310	0.0	434		
960 min Winter	9.316	0.0	540		
1440 min Winter	7.080	0.0	762		
2160 min Winter	5.366	0.0	1124		
2880 min Winter	4.423	0.0	1496		
4320 min Winter	3.404	0.0	2204		
5760 min Winter	2.860	0.0	2920		
7200 min Winter	2.528	0.0	3664		
8640 min Winter	2.303	0.0	4472		
10080 min Winter	2.142	0.0	5136		
©1982-2018 Innovyze					

INTRADO		Page 3																																	
Castle House 63-69 Cardiff Road CF15 7RD	IR20062 Plymouth House Individual Drives																																		
Date 18/06/2020 17:42 File Individual drive.SRCX	Designed by Clare Checked by																																		
XP Solutions																																			
Source Control 2018.1.1																																			
<u>Rainfall Details</u> <table> <tr> <td>Rainfall Model</td> <td>FEH</td> </tr> <tr> <td>Return Period (years)</td> <td>100</td> </tr> <tr> <td>FEH Rainfall Version</td> <td>2013</td> </tr> <tr> <td>Site Location</td> <td>GB 305400 204900 SO 05400 04900</td> </tr> <tr> <td>Data Type</td> <td>Catchment</td> </tr> <tr> <td>Summer Storms</td> <td>Yes</td> </tr> <tr> <td>Winter Storms</td> <td>Yes</td> </tr> <tr> <td>Cv (Summer)</td> <td>0.750</td> </tr> <tr> <td>Cv (Winter)</td> <td>0.850</td> </tr> <tr> <td>Shortest Storm (mins)</td> <td>15</td> </tr> <tr> <td>Longest Storm (mins)</td> <td>10080</td> </tr> <tr> <td>Climate Change %</td> <td>+30</td> </tr> </table> <u>Time Area Diagram</u> Total Area (ha) 0.003 <table> <thead> <tr> <th colspan="2">Time (mins)</th> <th>Area</th> </tr> <tr> <th>From:</th> <th>To:</th> <th>(ha)</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>4</td> <td>0.003</td> </tr> </tbody> </table>			Rainfall Model	FEH	Return Period (years)	100	FEH Rainfall Version	2013	Site Location	GB 305400 204900 SO 05400 04900	Data Type	Catchment	Summer Storms	Yes	Winter Storms	Yes	Cv (Summer)	0.750	Cv (Winter)	0.850	Shortest Storm (mins)	15	Longest Storm (mins)	10080	Climate Change %	+30	Time (mins)		Area	From:	To:	(ha)	0	4	0.003
Rainfall Model	FEH																																		
Return Period (years)	100																																		
FEH Rainfall Version	2013																																		
Site Location	GB 305400 204900 SO 05400 04900																																		
Data Type	Catchment																																		
Summer Storms	Yes																																		
Winter Storms	Yes																																		
Cv (Summer)	0.750																																		
Cv (Winter)	0.850																																		
Shortest Storm (mins)	15																																		
Longest Storm (mins)	10080																																		
Climate Change %	+30																																		
Time (mins)		Area																																	
From:	To:	(ha)																																	
0	4	0.003																																	
©1982-2018 Innovyze																																			

INTRADO		Page 4																								
Castle House 63-69 Cardiff Road CF15 7RD	IR20062 Plymouth House Individual Drives																									
Date 18/06/2020 17:42 File Individual drive.SRCX	Designed by Clare Checked by																									
XP Solutions																										
Source Control 2018.1.1																										
<u>Model Details</u> Storage is Online Cover Level (m) 48.000 <u>Porous Car Park Structure</u> <table> <tr> <td>Infiltration Coefficient Base (m/hr)</td> <td>0.04000</td> <td>Width (m)</td> <td>4.8</td> </tr> <tr> <td>Membrane Percolation (mm/hr)</td> <td>1000</td> <td>Length (m)</td> <td>5.4</td> </tr> <tr> <td>Max Percolation (l/s)</td> <td>7.2</td> <td>Slope (1:X)</td> <td>500.0</td> </tr> <tr> <td>Safety Factor</td> <td>2.0</td> <td>Depression Storage (mm)</td> <td>5</td> </tr> <tr> <td>Porosity</td> <td>0.30</td> <td>Evaporation (mm/day)</td> <td>3</td> </tr> <tr> <td>Invert Level (m)</td> <td>47.520</td> <td>Cap Volume Depth (m)</td> <td>0.350</td> </tr> </table>			Infiltration Coefficient Base (m/hr)	0.04000	Width (m)	4.8	Membrane Percolation (mm/hr)	1000	Length (m)	5.4	Max Percolation (l/s)	7.2	Slope (1:X)	500.0	Safety Factor	2.0	Depression Storage (mm)	5	Porosity	0.30	Evaporation (mm/day)	3	Invert Level (m)	47.520	Cap Volume Depth (m)	0.350
Infiltration Coefficient Base (m/hr)	0.04000	Width (m)	4.8																							
Membrane Percolation (mm/hr)	1000	Length (m)	5.4																							
Max Percolation (l/s)	7.2	Slope (1:X)	500.0																							
Safety Factor	2.0	Depression Storage (mm)	5																							
Porosity	0.30	Evaporation (mm/day)	3																							
Invert Level (m)	47.520	Cap Volume Depth (m)	0.350																							
©1982-2018 Innovyze																										

INTRADO

Castle House
63-69 Cardiff Road
CF15 7RD

IR20062
Plymouth House
Individual Drives

Date 19/06/2020 14:36
File Bio retention plot 1.SRCX

Designed by Clare
Checked by

XP Solutions

Source Control 2018.1.1

Page 1



Summary of Results for 100 year Return Period (+30%)

Half Drain Time : 1 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	47.486	0.286	0.0	4.1	4.2	0.3	O K
30 min Summer	47.498	0.298	0.0	4.2	4.2	0.4	O K
60 min Summer	47.428	0.228	0.0	3.9	3.9	0.2	O K
120 min Summer	47.238	0.038	0.0	3.0	3.0	0.0	O K
180 min Summer	47.200	0.000	0.0	2.5	2.5	0.0	O K
240 min Summer	47.200	0.000	0.0	2.1	2.1	0.0	O K
360 min Summer	47.200	0.000	0.0	1.6	1.6	0.0	O K
480 min Summer	47.200	0.000	0.0	1.3	1.3	0.0	O K
600 min Summer	47.200	0.000	0.0	1.1	1.1	0.0	O K
720 min Summer	47.200	0.000	0.0	1.0	1.0	0.0	O K
960 min Summer	47.200	0.000	0.0	0.8	0.8	0.0	O K
1440 min Summer	47.200	0.000	0.0	0.6	0.6	0.0	O K
2160 min Summer	47.200	0.000	0.0	0.5	0.5	0.0	O K
2880 min Summer	47.200	0.000	0.0	0.4	0.4	0.0	O K
4320 min Summer	47.200	0.000	0.0	0.3	0.3	0.0	O K
5760 min Summer	47.200	0.000	0.0	0.3	0.3	0.0	O K
7200 min Summer	47.200	0.000	0.0	0.2	0.2	0.0	O K
8640 min Summer	47.200	0.000	0.0	0.2	0.2	0.0	O K
10080 min Summer	47.200	0.000	0.0	0.2	0.2	0.0	O K
15 min Winter	47.504	0.304	0.0	4.2	4.2	0.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	107.640	0.0	2.2	11
30 min Summer	79.560	0.0	3.3	19
60 min Summer	56.160	0.0	4.6	34
120 min Summer	35.945	0.0	5.9	64
180 min Summer	27.800	0.0	6.9	0
240 min Summer	23.173	0.0	7.6	0
360 min Summer	17.875	0.0	8.8	0
480 min Summer	14.810	0.0	9.8	0
600 min Summer	12.775	0.0	10.5	0
720 min Summer	11.310	0.0	11.2	0
960 min Summer	9.316	0.0	12.3	0
1440 min Summer	7.080	0.0	14.0	0
2160 min Summer	5.366	0.0	15.9	0
2880 min Summer	4.423	0.0	17.5	0
4320 min Summer	3.404	0.0	20.2	0
5760 min Summer	2.860	0.0	22.7	0
7200 min Summer	2.528	0.0	25.0	0
8640 min Summer	2.303	0.0	27.4	0
10080 min Summer	2.142	0.0	29.7	0
15 min Winter	107.640	0.0	2.5	12

©1982-2018 Innovyze

INTRADO		Page 2					
Castle House 63-69 Cardiff Road CF15 7RD	IR20062 Plymouth House Individual Drives						
Date 19/06/2020 14:36 File Bio retention plot 1.SRCX	Designed by Clare Checked by						
XP Solutions							
Source Control 2018.1.1							
<u>Summary of Results for 100 year Return Period (+30%)</u>							
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	47.469	0.269	0.0	4.1	4.1	0.3	O K
60 min Winter	47.340	0.140	0.0	3.5	3.5	0.1	O K
120 min Winter	47.200	0.000	0.0	2.3	2.3	0.0	O K
180 min Winter	47.200	0.000	0.0	1.8	1.8	0.0	O K
240 min Winter	47.200	0.000	0.0	1.5	1.5	0.0	O K
360 min Winter	47.200	0.000	0.0	1.2	1.2	0.0	O K
480 min Winter	47.200	0.000	0.0	1.0	1.0	0.0	O K
600 min Winter	47.200	0.000	0.0	0.8	0.8	0.0	O K
720 min Winter	47.200	0.000	0.0	0.7	0.7	0.0	O K
960 min Winter	47.200	0.000	0.0	0.6	0.6	0.0	O K
1440 min Winter	47.200	0.000	0.0	0.5	0.5	0.0	O K
2160 min Winter	47.200	0.000	0.0	0.4	0.4	0.0	O K
2880 min Winter	47.200	0.000	0.0	0.3	0.3	0.0	O K
4320 min Winter	47.200	0.000	0.0	0.2	0.2	0.0	O K
5760 min Winter	47.200	0.000	0.0	0.2	0.2	0.0	O K
7200 min Winter	47.200	0.000	0.0	0.2	0.2	0.0	O K
8640 min Winter	47.200	0.000	0.0	0.2	0.2	0.0	O K
10080 min Winter	47.200	0.000	0.0	0.1	0.1	0.0	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)			
30 min Winter	79.560	0.0	3.7	19			
60 min Winter	56.160	0.0	5.2	34			
120 min Winter	35.945	0.0	6.7	0			
180 min Winter	27.800	0.0	7.8	0			
240 min Winter	23.173	0.0	8.7	0			
360 min Winter	17.875	0.0	10.0	0			
480 min Winter	14.810	0.0	11.1	0			
600 min Winter	12.775	0.0	11.9	0			
720 min Winter	11.310	0.0	12.7	0			
960 min Winter	9.316	0.0	13.9	0			
1440 min Winter	7.080	0.0	15.9	0			
2160 min Winter	5.366	0.0	18.1	0			
2880 min Winter	4.423	0.0	19.8	0			
4320 min Winter	3.404	0.0	22.9	0			
5760 min Winter	2.860	0.0	25.7	0			
7200 min Winter	2.528	0.0	28.4	0			
8640 min Winter	2.303	0.0	31.0	0			
10080 min Winter	2.142	0.0	33.6	0			
©1982-2018 Innovyze							

INTRADO		Page 3
Castle House 63-69 Cardiff Road CF15 7RD	IR20062 Plymouth House Individual Drives	
Date 19/06/2020 14:36 File Bio retention plot 1.SRCX	Designed by Clare Checked by	
XP Solutions Source Control 2018.1.1		

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 305400 204900 SO 05400 04900
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.011

Time (mins)		Area
From:	To:	(ha)
0	4	0.011

©1982-2018 Innovyze

INTRADO		Page 4
Castle House 63-69 Cardiff Road CF15 7RD	IR20062 Plymouth House Individual Drives	
Date 19/06/2020 14:36 File Bio retention plot 1.SRCX	Designed by Clare Checked by	
XP Solutions Source Control 2018.1.1		

Model Details

Storage is Online Cover Level (m) 48.000

Bio-Retention Area Structure

Invert Level (m) 47.200 Infiltration Coefficient Base (m/hr) 0.04000
 Porosity 1.00 Infiltration Coefficient Side (m/hr) 0.04000
 Safety Factor 2.0

Depth (m)	Area (m ²)	Perimeter (m)	Depth (m)	Area (m ²)	Perimeter (m)
0.000	0.7	11.400	0.201	2.2	11.400
0.200	0.7	11.400	0.800	2.2	11.400

Filtration Outflow Control

Permeability Coefficient (m/s) 0.040000 Area (m²) 0.700
 Safety Factor 10.000 Invert Level (m) 47.200
 Bed Depth (m) 0.600

©1982-2018 Innovyze

INTRADO

Page 1

Castle House
63-69 Cardiff Road
CF15 7RD

IR20062
Plymouth House
Individual Drives

Date 19/06/2020 14:43
File Bio retention plot 2.SRCX

Designed by Clare
Checked by

XP Solutions

Source Control 2018.1.1

Micro Drainage

Summary of Results for 100 year Return Period (+30%)

Half Drain Time : 1 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	47.579	0.379	0.0	3.5	3.6	0.5	O K
30 min Summer	47.604	0.404	0.0	3.6	3.6	0.5	O K
60 min Summer	47.527	0.327	0.0	3.4	3.4	0.4	O K
120 min Summer	47.359	0.159	0.0	2.9	2.9	0.1	O K
180 min Summer	47.206	0.006	0.0	2.4	2.4	0.0	O K
240 min Summer	47.200	0.000	0.0	2.1	2.1	0.0	O K
360 min Summer	47.200	0.000	0.0	1.6	1.6	0.0	O K
480 min Summer	47.200	0.000	0.0	1.3	1.3	0.0	O K
600 min Summer	47.200	0.000	0.0	1.1	1.1	0.0	O K
720 min Summer	47.200	0.000	0.0	1.0	1.0	0.0	O K
960 min Summer	47.200	0.000	0.0	0.8	0.8	0.0	O K
1440 min Summer	47.200	0.000	0.0	0.6	0.6	0.0	O K
2160 min Summer	47.200	0.000	0.0	0.5	0.5	0.0	O K
2880 min Summer	47.200	0.000	0.0	0.4	0.4	0.0	O K
4320 min Summer	47.200	0.000	0.0	0.3	0.3	0.0	O K
5760 min Summer	47.200	0.000	0.0	0.3	0.3	0.0	O K
7200 min Summer	47.200	0.000	0.0	0.2	0.2	0.0	O K
8640 min Summer	47.200	0.000	0.0	0.2	0.2	0.0	O K
10080 min Summer	47.200	0.000	0.0	0.2	0.2	0.0	O K
15 min Winter	47.614	0.414	0.0	3.6	3.7	0.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	107.640	0.0	2.2	12
30 min Summer	79.560	0.0	3.3	20
60 min Summer	56.160	0.0	4.6	36
120 min Summer	35.945	0.0	5.9	64
180 min Summer	27.800	0.0	6.9	92
240 min Summer	23.173	0.0	7.6	0
360 min Summer	17.875	0.0	8.8	0
480 min Summer	14.810	0.0	9.8	0
600 min Summer	12.775	0.0	10.5	0
720 min Summer	11.310	0.0	11.2	0
960 min Summer	9.316	0.0	12.3	0
1440 min Summer	7.080	0.0	14.0	0
2160 min Summer	5.366	0.0	15.9	0
2880 min Summer	4.423	0.0	17.5	0
4320 min Summer	3.404	0.0	20.2	0
5760 min Summer	2.860	0.0	22.7	0
7200 min Summer	2.528	0.0	25.0	0
8640 min Summer	2.303	0.0	27.4	0
10080 min Summer	2.142	0.0	29.7	0
15 min Winter	107.640	0.0	2.5	12

©1982-2018 Innovyze

INTRADO		Page 2					
Castle House 63-69 Cardiff Road CF15 7RD	IR20062 Plymouth House Individual Drives						
Date 19/06/2020 14:43 File Bio retention plot 2.SRCX	Designed by Clare Checked by						
XP Solutions							
Source Control 2018.1.1							
<u>Summary of Results for 100 year Return Period (+30%)</u>							
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	47.592	0.392	0.0	3.6	3.6	0.5	O K
60 min Winter	47.458	0.258	0.0	3.2	3.2	0.2	O K
120 min Winter	47.200	0.000	0.0	2.3	2.3	0.0	O K
180 min Winter	47.200	0.000	0.0	1.8	1.8	0.0	O K
240 min Winter	47.200	0.000	0.0	1.5	1.5	0.0	O K
360 min Winter	47.200	0.000	0.0	1.2	1.2	0.0	O K
480 min Winter	47.200	0.000	0.0	1.0	1.0	0.0	O K
600 min Winter	47.200	0.000	0.0	0.8	0.8	0.0	O K
720 min Winter	47.200	0.000	0.0	0.7	0.7	0.0	O K
960 min Winter	47.200	0.000	0.0	0.6	0.6	0.0	O K
1440 min Winter	47.200	0.000	0.0	0.5	0.5	0.0	O K
2160 min Winter	47.200	0.000	0.0	0.4	0.4	0.0	O K
2880 min Winter	47.200	0.000	0.0	0.3	0.3	0.0	O K
4320 min Winter	47.200	0.000	0.0	0.2	0.2	0.0	O K
5760 min Winter	47.200	0.000	0.0	0.2	0.2	0.0	O K
7200 min Winter	47.200	0.000	0.0	0.2	0.2	0.0	O K
8640 min Winter	47.200	0.000	0.0	0.2	0.2	0.0	O K
10080 min Winter	47.200	0.000	0.0	0.1	0.1	0.0	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)			
30 min Winter	79.560	0.0	3.7	20			
60 min Winter	56.160	0.0	5.3	36			
120 min Winter	35.945	0.0	6.7	0			
180 min Winter	27.800	0.0	7.8	0			
240 min Winter	23.173	0.0	8.7	0			
360 min Winter	17.875	0.0	10.0	0			
480 min Winter	14.810	0.0	11.1	0			
600 min Winter	12.775	0.0	11.9	0			
720 min Winter	11.310	0.0	12.7	0			
960 min Winter	9.316	0.0	13.9	0			
1440 min Winter	7.080	0.0	15.9	0			
2160 min Winter	5.366	0.0	18.1	0			
2880 min Winter	4.423	0.0	19.8	0			
4320 min Winter	3.404	0.0	22.9	0			
5760 min Winter	2.860	0.0	25.7	0			
7200 min Winter	2.528	0.0	28.4	0			
8640 min Winter	2.303	0.0	31.0	0			
10080 min Winter	2.142	0.0	33.6	0			
©1982-2018 Innovyze							

INTRADO		Page 3
Castle House 63-69 Cardiff Road CF15 7RD	IR20062 Plymouth House Individual Drives	
Date 19/06/2020 14:43 File Bio retention plot 2.SRCX	Designed by Clare Checked by	
XP Solutions Source Control 2018.1.1		

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 305400 204900 SO 05400 04900
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.011

Time (mins)		Area
From:	To:	(ha)
0	4	0.011

©1982-2018 Innovyze

INTRADO		Page 4
Castle House 63-69 Cardiff Road CF15 7RD	IR20062 Plymouth House Individual Drives	
Date 19/06/2020 14:43 File Bio retention plot 2.SRCX	Designed by Clare Checked by	
XP Solutions Source Control 2018.1.1		

Model Details

Storage is Online Cover Level (m) 48.000

Bio-Retention Area Structure

Invert Level (m) 47.200 Infiltration Coefficient Base (m/hr) 0.04000
 Porosity 1.00 Infiltration Coefficient Side (m/hr) 0.04000
 Safety Factor 2.0

Depth (m)	Area (m ²)	Perimeter (m)	Depth (m)	Area (m ²)	Perimeter (m)
0.000	0.6	5.700	0.201	2.0	5.700
0.200	0.6	5.700	0.800	2.0	5.700

Filtration Outflow Control

Permeability Coefficient (m/s) 0.040000 Area (m²) 0.600
 Safety Factor 10.000 Invert Level (m) 47.200
 Bed Depth (m) 0.800

©1982-2018 Innovyze

INTRADO

Castle House
63-69 Cardiff Road
CF15 7RD

Date 19/06/2020 14:40
File Bio retention plot 3.SRCX

XP Solutions

IR20062
Plymouth House
Individual Drives

Designed by Clare
Checked by

Source Control 2018.1.1

Page 1



Summary of Results for 100 year Return Period (+30%)

Half Drain Time : 1 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	47.480	0.280	0.0	4.1	4.1	0.3	O K
30 min Summer	47.491	0.291	0.0	4.2	4.2	0.4	O K
60 min Summer	47.427	0.227	0.0	3.9	3.9	0.2	O K
120 min Summer	47.238	0.038	0.0	3.0	3.0	0.0	O K
180 min Summer	47.200	0.000	0.0	2.5	2.5	0.0	O K
240 min Summer	47.200	0.000	0.0	2.1	2.1	0.0	O K
360 min Summer	47.200	0.000	0.0	1.6	1.6	0.0	O K
480 min Summer	47.200	0.000	0.0	1.3	1.3	0.0	O K
600 min Summer	47.200	0.000	0.0	1.1	1.1	0.0	O K
720 min Summer	47.200	0.000	0.0	1.0	1.0	0.0	O K
960 min Summer	47.200	0.000	0.0	0.8	0.8	0.0	O K
1440 min Summer	47.200	0.000	0.0	0.6	0.6	0.0	O K
2160 min Summer	47.200	0.000	0.0	0.5	0.5	0.0	O K
2880 min Summer	47.200	0.000	0.0	0.4	0.4	0.0	O K
4320 min Summer	47.200	0.000	0.0	0.3	0.3	0.0	O K
5760 min Summer	47.200	0.000	0.0	0.3	0.3	0.0	O K
7200 min Summer	47.200	0.000	0.0	0.2	0.2	0.0	O K
8640 min Summer	47.200	0.000	0.0	0.2	0.2	0.0	O K
10080 min Summer	47.200	0.000	0.0	0.2	0.2	0.0	O K
15 min Winter	47.498	0.298	0.0	4.2	4.2	0.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	107.640	0.0	2.2	11
30 min Summer	79.560	0.0	3.3	19
60 min Summer	56.160	0.0	4.6	34
120 min Summer	35.945	0.0	5.9	64
180 min Summer	27.800	0.0	6.9	0
240 min Summer	23.173	0.0	7.6	0
360 min Summer	17.875	0.0	8.8	0
480 min Summer	14.810	0.0	9.8	0
600 min Summer	12.775	0.0	10.5	0
720 min Summer	11.310	0.0	11.2	0
960 min Summer	9.316	0.0	12.3	0
1440 min Summer	7.080	0.0	14.0	0
2160 min Summer	5.366	0.0	15.9	0
2880 min Summer	4.423	0.0	17.5	0
4320 min Summer	3.404	0.0	20.2	0
5760 min Summer	2.860	0.0	22.7	0
7200 min Summer	2.528	0.0	25.0	0
8640 min Summer	2.303	0.0	27.4	0
10080 min Summer	2.142	0.0	29.7	0
15 min Winter	107.640	0.0	2.5	12

©1982-2018 Innovyze

INTRADO		Page 2					
Castle House 63-69 Cardiff Road CF15 7RD	IR20062 Plymouth House Individual Drives						
Date 19/06/2020 14:40 File Bio retention plot 3.SRCX	Designed by Clare Checked by						
XP Solutions							
Source Control 2018.1.1							
<u>Summary of Results for 100 year Return Period (+30%)</u>							
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	47.465	0.265	0.0	4.0	4.0	0.3	O K
60 min Winter	47.341	0.141	0.0	3.5	3.5	0.1	O K
120 min Winter	47.200	0.000	0.0	2.3	2.3	0.0	O K
180 min Winter	47.200	0.000	0.0	1.8	1.8	0.0	O K
240 min Winter	47.200	0.000	0.0	1.5	1.5	0.0	O K
360 min Winter	47.200	0.000	0.0	1.2	1.2	0.0	O K
480 min Winter	47.200	0.000	0.0	1.0	1.0	0.0	O K
600 min Winter	47.200	0.000	0.0	0.8	0.8	0.0	O K
720 min Winter	47.200	0.000	0.0	0.7	0.7	0.0	O K
960 min Winter	47.200	0.000	0.0	0.6	0.6	0.0	O K
1440 min Winter	47.200	0.000	0.0	0.5	0.5	0.0	O K
2160 min Winter	47.200	0.000	0.0	0.4	0.4	0.0	O K
2880 min Winter	47.200	0.000	0.0	0.3	0.3	0.0	O K
4320 min Winter	47.200	0.000	0.0	0.2	0.2	0.0	O K
5760 min Winter	47.200	0.000	0.0	0.2	0.2	0.0	O K
7200 min Winter	47.200	0.000	0.0	0.2	0.2	0.0	O K
8640 min Winter	47.200	0.000	0.0	0.2	0.2	0.0	O K
10080 min Winter	47.200	0.000	0.0	0.1	0.1	0.0	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)			
30 min Winter	79.560	0.0	3.7	20			
60 min Winter	56.160	0.0	5.2	34			
120 min Winter	35.945	0.0	6.7	0			
180 min Winter	27.800	0.0	7.8	0			
240 min Winter	23.173	0.0	8.7	0			
360 min Winter	17.875	0.0	10.0	0			
480 min Winter	14.810	0.0	11.1	0			
600 min Winter	12.775	0.0	11.9	0			
720 min Winter	11.310	0.0	12.7	0			
960 min Winter	9.316	0.0	13.9	0			
1440 min Winter	7.080	0.0	15.9	0			
2160 min Winter	5.366	0.0	18.1	0			
2880 min Winter	4.423	0.0	19.8	0			
4320 min Winter	3.404	0.0	22.9	0			
5760 min Winter	2.860	0.0	25.7	0			
7200 min Winter	2.528	0.0	28.4	0			
8640 min Winter	2.303	0.0	31.0	0			
10080 min Winter	2.142	0.0	33.6	0			
©1982-2018 Innovyze							

INTRADO		Page 3
Castle House 63-69 Cardiff Road CF15 7RD	IR20062 Plymouth House Individual Drives	
Date 19/06/2020 14:40 File Bio retention plot 3.SRCX	Designed by Clare Checked by	
XP Solutions Source Control 2018.1.1		

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 305400 204900 SO 05400 04900
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.011

Time (mins)	Area
From:	To: (ha)
0	4 0.011

©1982-2018 Innovyze

INTRADO		Page 4
Castle House 63-69 Cardiff Road CF15 7RD	IR20062 Plymouth House Individual Drives	
Date 19/06/2020 14:40 File Bio retention plot 3.SRCX	Designed by Clare Checked by	
XP Solutions Source Control 2018.1.1		

Model Details

Storage is Online Cover Level (m) 48.000

Bio-Retention Area Structure

Invert Level (m) 47.200 Infiltration Coefficient Base (m/hr) 0.04000
 Porosity 1.00 Infiltration Coefficient Side (m/hr) 0.04000
 Safety Factor 2.0

Depth (m)	Area (m ²)	Perimeter (m)	Depth (m)	Area (m ²)	Perimeter (m)
0.000	0.7	6.258	0.201	2.4	6.258
0.200	0.7	6.258	0.800	2.4	6.258

Filtration Outflow Control

Permeability Coefficient (m/s) 0.040000 Area (m²) 0.700
 Safety Factor 10.000 Invert Level (m) 47.200
 Bed Depth (m) 0.600

©1982-2018 Innovyze

INTRADO

Page 1

Castle House 63-69 Cardiff Road CF15 7RD	IR20062 Plymouth House Individual Drives	
Date 19/06/2020 20:04 File Bio retention plot 4.SRCX	Designed by Clare Checked by	
XP Solutions		

Source Control 2018.1.1

Summary of Results for 100 year Return Period (+30%)

Half Drain Time : 1 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	47.497	0.297	0.0	3.8	3.9	0.4	O K
30 min Summer	47.513	0.313	0.0	3.9	3.9	0.4	O K
60 min Summer	47.446	0.246	0.0	3.7	3.7	0.2	O K
120 min Summer	47.245	0.045	0.0	3.0	3.0	0.0	O K
180 min Summer	47.200	0.000	0.0	2.5	2.5	0.0	O K
240 min Summer	47.200	0.000	0.0	2.1	2.1	0.0	O K
360 min Summer	47.200	0.000	0.0	1.6	1.6	0.0	O K
480 min Summer	47.200	0.000	0.0	1.3	1.3	0.0	O K
600 min Summer	47.200	0.000	0.0	1.1	1.1	0.0	O K
720 min Summer	47.200	0.000	0.0	1.0	1.0	0.0	O K
960 min Summer	47.200	0.000	0.0	0.8	0.8	0.0	O K
1440 min Summer	47.200	0.000	0.0	0.6	0.6	0.0	O K
2160 min Summer	47.200	0.000	0.0	0.5	0.5	0.0	O K
2880 min Summer	47.200	0.000	0.0	0.4	0.4	0.0	O K
4320 min Summer	47.200	0.000	0.0	0.3	0.3	0.0	O K
5760 min Summer	47.200	0.000	0.0	0.3	0.3	0.0	O K
7200 min Summer	47.200	0.000	0.0	0.2	0.2	0.0	O K
8640 min Summer	47.200	0.000	0.0	0.2	0.2	0.0	O K
10080 min Summer	47.200	0.000	0.0	0.2	0.2	0.0	O K
15 min Winter	47.523	0.323	0.0	3.9	4.0	0.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	107.640	0.0	2.3	11
30 min Summer	79.560	0.0	3.2	19
60 min Summer	56.160	0.0	4.6	34
120 min Summer	35.945	0.0	5.9	64
180 min Summer	27.800	0.0	6.9	0
240 min Summer	23.173	0.0	7.6	0
360 min Summer	17.875	0.0	8.8	0
480 min Summer	14.810	0.0	9.8	0
600 min Summer	12.775	0.0	10.5	0
720 min Summer	11.310	0.0	11.2	0
960 min Summer	9.316	0.0	12.3	0
1440 min Summer	7.080	0.0	14.0	0
2160 min Summer	5.366	0.0	15.9	0
2880 min Summer	4.423	0.0	17.5	0
4320 min Summer	3.404	0.0	20.2	0
5760 min Summer	2.860	0.0	22.7	0
7200 min Summer	2.528	0.0	25.0	0
8640 min Summer	2.303	0.0	27.4	0
10080 min Summer	2.142	0.0	29.7	0
15 min Winter	107.640	0.0	2.6	12

©1982-2018 Innovyze

INTRADO

Page 2

Castle House 63-69 Cardiff Road CF15 7RD	IR20062 Plymouth House Individual Drives
Date 19/06/2020 20:04 File Bio retention plot 4.SRCX	Designed by Clare Checked by
XP Solutions	Source Control 2018.1.1

Micro Drainage

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	47.493	0.293	0.0	3.8	3.9	0.4	O K
60 min Winter	47.370	0.170	0.0	3.4	3.4	0.1	O K
120 min Winter	47.200	0.000	0.0	2.3	2.3	0.0	O K
180 min Winter	47.200	0.000	0.0	1.8	1.8	0.0	O K
240 min Winter	47.200	0.000	0.0	1.5	1.5	0.0	O K
360 min Winter	47.200	0.000	0.0	1.2	1.2	0.0	O K
480 min Winter	47.200	0.000	0.0	1.0	1.0	0.0	O K
600 min Winter	47.200	0.000	0.0	0.8	0.8	0.0	O K
720 min Winter	47.200	0.000	0.0	0.7	0.7	0.0	O K
960 min Winter	47.200	0.000	0.0	0.6	0.6	0.0	O K
1440 min Winter	47.200	0.000	0.0	0.5	0.5	0.0	O K
2160 min Winter	47.200	0.000	0.0	0.4	0.4	0.0	O K
2880 min Winter	47.200	0.000	0.0	0.3	0.3	0.0	O K
4320 min Winter	47.200	0.000	0.0	0.2	0.2	0.0	O K
5760 min Winter	47.200	0.000	0.0	0.2	0.2	0.0	O K
7200 min Winter	47.200	0.000	0.0	0.2	0.2	0.0	O K
8640 min Winter	47.200	0.000	0.0	0.2	0.2	0.0	O K
10080 min Winter	47.200	0.000	0.0	0.1	0.1	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	79.560	0.0	3.7	20
60 min Winter	56.160	0.0	5.2	34
120 min Winter	35.945	0.0	6.7	0
180 min Winter	27.800	0.0	7.8	0
240 min Winter	23.173	0.0	8.7	0
360 min Winter	17.875	0.0	10.0	0
480 min Winter	14.810	0.0	11.1	0
600 min Winter	12.775	0.0	11.9	0
720 min Winter	11.310	0.0	12.7	0
960 min Winter	9.316	0.0	13.9	0
1440 min Winter	7.080	0.0	15.9	0
2160 min Winter	5.366	0.0	18.1	0
2880 min Winter	4.423	0.0	19.8	0
4320 min Winter	3.404	0.0	22.9	0
5760 min Winter	2.860	0.0	25.7	0
7200 min Winter	2.528	0.0	28.4	0
8640 min Winter	2.303	0.0	31.0	0
10080 min Winter	2.142	0.0	33.6	0

©1982-2018 Innovyze

INTRADO		Page 3
Castle House 63-69 Cardiff Road CF15 7RD	IR20062 Plymouth House Individual Drives	
Date 19/06/2020 20:04 File Bio retention plot 4.SRCX	Designed by Clare Checked by	
XP Solutions Source Control 2018.1.1		

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 305400 204900 SO 05400 04900
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.850
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.011

	Time (mins)	Area
From:	To:	(ha)
	0	4 0.011

©1982-2018 Innovyze

INTRADO		Page 4
Castle House 63-69 Cardiff Road CF15 7RD	IR20062 Plymouth House Individual Drives	
Date 19/06/2020 20:04 File Bio retention plot 4.SRCX	Designed by Clare Checked by	
XP Solutions Source Control 2018.1.1		

Model Details

Storage is Online Cover Level (m) 48.000

Bio-Retention Area Structure

Invert Level (m) 47.200 Infiltration Coefficient Base (m/hr) 0.04000
 Porosity 1.00 Infiltration Coefficient Side (m/hr) 0.04000
 Safety Factor 2.0

Depth (m)	Area (m ²)	Perimeter (m)	Depth (m)	Area (m ²)	Perimeter (m)
0.000	0.7	10.100	0.201	2.4	10.100
0.200	0.7	10.100	0.800	2.4	100.100

Filtration Outflow Control

Permeability Coefficient (m/s) 0.040000 Area (m²) 0.700
 Safety Factor 10.000 Invert Level (m) 47.200
 Bed Depth (m) 0.800

©1982-2018 Innovyze

INTRADO				Page 1																																																																																																																																																																																																																			
Castle House 63-69 Cardiff Road CF15 7RD			IR20062 Plymouth House Shared Drive																																																																																																																																																																																																																				
Date 18/06/2020 17:38 File Shared Drivce.SRCX			Designed by Clare Checked by																																																																																																																																																																																																																				
XP Solutions			Source Control 2018.1.1																																																																																																																																																																																																																				
Summary of Results for 100 year Return Period (+30%) Half Drain Time : 54 minutes. <table><thead><tr><th>Storm Event</th><th>Max Level (m)</th><th>Max Depth (m)</th><th>Max Infiltration (l/s)</th><th>Max Volume (m³)</th><th>Status</th></tr></thead><tbody><tr><td>15 min Summer</td><td>47.599</td><td>0.079</td><td>0.9</td><td>2.1</td><td>O K</td></tr><tr><td>30 min Summer</td><td>47.621</td><td>0.101</td><td>0.9</td><td>3.2</td><td>O K</td></tr><tr><td>60 min Summer</td><td>47.643</td><td>0.123</td><td>0.9</td><td>4.4</td><td>O K</td></tr><tr><td>120 min Summer</td><td>47.652</td><td>0.132</td><td>0.9</td><td>4.8</td><td>O K</td></tr><tr><td>180 min Summer</td><td>47.654</td><td>0.134</td><td>0.9</td><td>4.9</td><td>O K</td></tr><tr><td>240 min Summer</td><td>47.652</td><td>0.132</td><td>0.9</td><td>4.8</td><td>O K</td></tr><tr><td>360 min Summer</td><td>47.644</td><td>0.124</td><td>0.9</td><td>4.4</td><td>O K</td></tr><tr><td>480 min Summer</td><td>47.634</td><td>0.114</td><td>0.9</td><td>3.9</td><td>O K</td></tr><tr><td>600 min Summer</td><td>47.625</td><td>0.105</td><td>0.9</td><td>3.4</td><td>O K</td></tr><tr><td>720 min Summer</td><td>47.616</td><td>0.096</td><td>0.9</td><td>3.0</td><td>O K</td></tr><tr><td>960 min Summer</td><td>47.602</td><td>0.082</td><td>0.9</td><td>2.3</td><td>O K</td></tr><tr><td>1440 min Summer</td><td>47.588</td><td>0.068</td><td>0.8</td><td>1.5</td><td>O K</td></tr><tr><td>2160 min Summer</td><td>47.576</td><td>0.056</td><td>0.7</td><td>1.0</td><td>O K</td></tr><tr><td>2880 min Summer</td><td>47.569</td><td>0.049</td><td>0.6</td><td>0.8</td><td>O K</td></tr><tr><td>4320 min Summer</td><td>47.563</td><td>0.043</td><td>0.5</td><td>0.6</td><td>O K</td></tr><tr><td>5760 min Summer</td><td>47.560</td><td>0.040</td><td>0.4</td><td>0.5</td><td>O K</td></tr><tr><td>7200 min Summer</td><td>47.557</td><td>0.037</td><td>0.3</td><td>0.5</td><td>O K</td></tr><tr><td>8640 min Summer</td><td>47.556</td><td>0.036</td><td>0.3</td><td>0.4</td><td>O K</td></tr><tr><td>10080 min Summer</td><td>47.554</td><td>0.034</td><td>0.3</td><td>0.4</td><td>O K</td></tr><tr><td>15 min Winter</td><td>47.608</td><td>0.088</td><td>0.9</td><td>2.5</td><td>O K</td></tr></tbody></table> <table><thead><tr><th>Storm Event</th><th>Rain (mm/hr)</th><th>Flooded Volume (m³)</th><th>Time-Peak (mins)</th></tr></thead><tbody><tr><td>15 min Summer</td><td>107.640</td><td>0.0</td><td>16</td></tr><tr><td>30 min Summer</td><td>79.560</td><td>0.0</td><td>30</td></tr><tr><td>60 min Summer</td><td>56.160</td><td>0.0</td><td>50</td></tr><tr><td>120 min Summer</td><td>35.945</td><td>0.0</td><td>84</td></tr><tr><td>180 min Summer</td><td>27.800</td><td>0.0</td><td>118</td></tr><tr><td>240 min Summer</td><td>23.173</td><td>0.0</td><td>154</td></tr><tr><td>360 min Summer</td><td>17.875</td><td>0.0</td><td>220</td></tr><tr><td>480 min Summer</td><td>14.810</td><td>0.0</td><td>284</td></tr><tr><td>600 min Summer</td><td>12.775</td><td>0.0</td><td>346</td></tr><tr><td>720 min Summer</td><td>11.310</td><td>0.0</td><td>406</td></tr><tr><td>960 min Summer</td><td>9.316</td><td>0.0</td><td>520</td></tr><tr><td>1440 min Summer</td><td>7.080</td><td>0.0</td><td>752</td></tr><tr><td>2160 min Summer</td><td>5.366</td><td>0.0</td><td>1104</td></tr><tr><td>2880 min Summer</td><td>4.423</td><td>0.0</td><td>1468</td></tr><tr><td>4320 min Summer</td><td>3.404</td><td>0.0</td><td>2196</td></tr><tr><td>5760 min Summer</td><td>2.860</td><td>0.0</td><td>2920</td></tr><tr><td>7200 min Summer</td><td>2.528</td><td>0.0</td><td>3656</td></tr><tr><td>8640 min Summer</td><td>2.303</td><td>0.0</td><td>4384</td></tr><tr><td>10080 min Summer</td><td>2.142</td><td>0.0</td><td>5096</td></tr><tr><td>15 min Winter</td><td>107.640</td><td>0.0</td><td>17</td></tr></tbody></table>						Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status	15 min Summer	47.599	0.079	0.9	2.1	O K	30 min Summer	47.621	0.101	0.9	3.2	O K	60 min Summer	47.643	0.123	0.9	4.4	O K	120 min Summer	47.652	0.132	0.9	4.8	O K	180 min Summer	47.654	0.134	0.9	4.9	O K	240 min Summer	47.652	0.132	0.9	4.8	O K	360 min Summer	47.644	0.124	0.9	4.4	O K	480 min Summer	47.634	0.114	0.9	3.9	O K	600 min Summer	47.625	0.105	0.9	3.4	O K	720 min Summer	47.616	0.096	0.9	3.0	O K	960 min Summer	47.602	0.082	0.9	2.3	O K	1440 min Summer	47.588	0.068	0.8	1.5	O K	2160 min Summer	47.576	0.056	0.7	1.0	O K	2880 min Summer	47.569	0.049	0.6	0.8	O K	4320 min Summer	47.563	0.043	0.5	0.6	O K	5760 min Summer	47.560	0.040	0.4	0.5	O K	7200 min Summer	47.557	0.037	0.3	0.5	O K	8640 min Summer	47.556	0.036	0.3	0.4	O K	10080 min Summer	47.554	0.034	0.3	0.4	O K	15 min Winter	47.608	0.088	0.9	2.5	O K	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)	15 min Summer	107.640	0.0	16	30 min Summer	79.560	0.0	30	60 min Summer	56.160	0.0	50	120 min Summer	35.945	0.0	84	180 min Summer	27.800	0.0	118	240 min Summer	23.173	0.0	154	360 min Summer	17.875	0.0	220	480 min Summer	14.810	0.0	284	600 min Summer	12.775	0.0	346	720 min Summer	11.310	0.0	406	960 min Summer	9.316	0.0	520	1440 min Summer	7.080	0.0	752	2160 min Summer	5.366	0.0	1104	2880 min Summer	4.423	0.0	1468	4320 min Summer	3.404	0.0	2196	5760 min Summer	2.860	0.0	2920	7200 min Summer	2.528	0.0	3656	8640 min Summer	2.303	0.0	4384	10080 min Summer	2.142	0.0	5096	15 min Winter	107.640	0.0	17
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status																																																																																																																																																																																																																		
15 min Summer	47.599	0.079	0.9	2.1	O K																																																																																																																																																																																																																		
30 min Summer	47.621	0.101	0.9	3.2	O K																																																																																																																																																																																																																		
60 min Summer	47.643	0.123	0.9	4.4	O K																																																																																																																																																																																																																		
120 min Summer	47.652	0.132	0.9	4.8	O K																																																																																																																																																																																																																		
180 min Summer	47.654	0.134	0.9	4.9	O K																																																																																																																																																																																																																		
240 min Summer	47.652	0.132	0.9	4.8	O K																																																																																																																																																																																																																		
360 min Summer	47.644	0.124	0.9	4.4	O K																																																																																																																																																																																																																		
480 min Summer	47.634	0.114	0.9	3.9	O K																																																																																																																																																																																																																		
600 min Summer	47.625	0.105	0.9	3.4	O K																																																																																																																																																																																																																		
720 min Summer	47.616	0.096	0.9	3.0	O K																																																																																																																																																																																																																		
960 min Summer	47.602	0.082	0.9	2.3	O K																																																																																																																																																																																																																		
1440 min Summer	47.588	0.068	0.8	1.5	O K																																																																																																																																																																																																																		
2160 min Summer	47.576	0.056	0.7	1.0	O K																																																																																																																																																																																																																		
2880 min Summer	47.569	0.049	0.6	0.8	O K																																																																																																																																																																																																																		
4320 min Summer	47.563	0.043	0.5	0.6	O K																																																																																																																																																																																																																		
5760 min Summer	47.560	0.040	0.4	0.5	O K																																																																																																																																																																																																																		
7200 min Summer	47.557	0.037	0.3	0.5	O K																																																																																																																																																																																																																		
8640 min Summer	47.556	0.036	0.3	0.4	O K																																																																																																																																																																																																																		
10080 min Summer	47.554	0.034	0.3	0.4	O K																																																																																																																																																																																																																		
15 min Winter	47.608	0.088	0.9	2.5	O K																																																																																																																																																																																																																		
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)																																																																																																																																																																																																																				
15 min Summer	107.640	0.0	16																																																																																																																																																																																																																				
30 min Summer	79.560	0.0	30																																																																																																																																																																																																																				
60 min Summer	56.160	0.0	50																																																																																																																																																																																																																				
120 min Summer	35.945	0.0	84																																																																																																																																																																																																																				
180 min Summer	27.800	0.0	118																																																																																																																																																																																																																				
240 min Summer	23.173	0.0	154																																																																																																																																																																																																																				
360 min Summer	17.875	0.0	220																																																																																																																																																																																																																				
480 min Summer	14.810	0.0	284																																																																																																																																																																																																																				
600 min Summer	12.775	0.0	346																																																																																																																																																																																																																				
720 min Summer	11.310	0.0	406																																																																																																																																																																																																																				
960 min Summer	9.316	0.0	520																																																																																																																																																																																																																				
1440 min Summer	7.080	0.0	752																																																																																																																																																																																																																				
2160 min Summer	5.366	0.0	1104																																																																																																																																																																																																																				
2880 min Summer	4.423	0.0	1468																																																																																																																																																																																																																				
4320 min Summer	3.404	0.0	2196																																																																																																																																																																																																																				
5760 min Summer	2.860	0.0	2920																																																																																																																																																																																																																				
7200 min Summer	2.528	0.0	3656																																																																																																																																																																																																																				
8640 min Summer	2.303	0.0	4384																																																																																																																																																																																																																				
10080 min Summer	2.142	0.0	5096																																																																																																																																																																																																																				
15 min Winter	107.640	0.0	17																																																																																																																																																																																																																				
©1982-2018 Innovyze																																																																																																																																																																																																																							

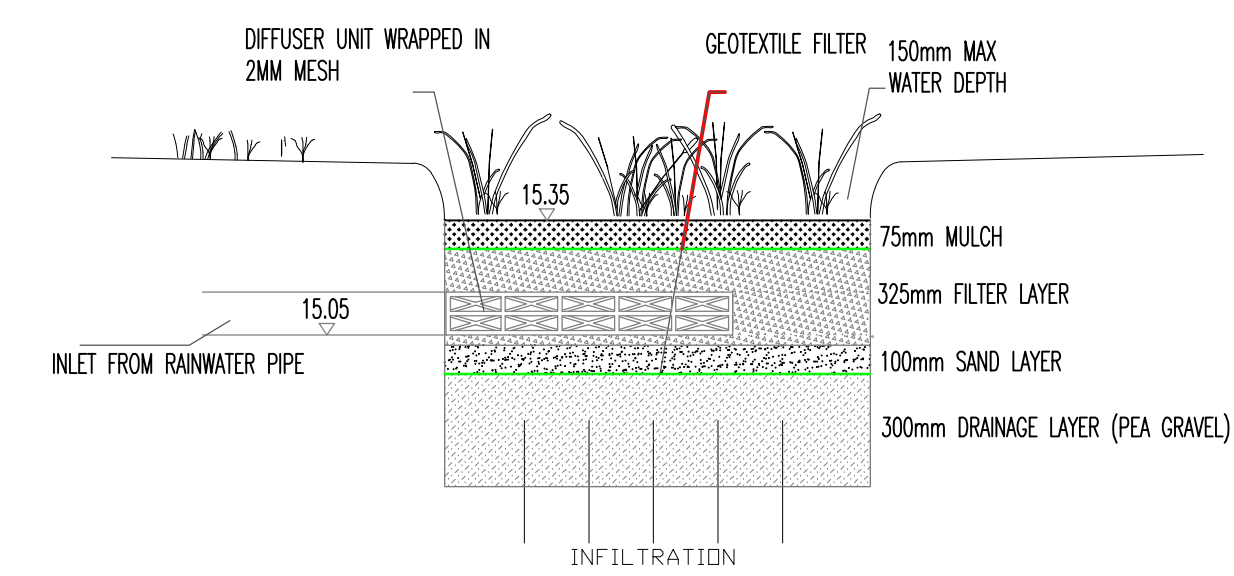
INTRADO				Page 2	
Castle House 63-69 Cardiff Road CF15 7RD		IR20062 Plymouth House Shared Drive			
Date 18/06/2020 17:38 File Shared Drivce.SRCX		Designed by Clare Checked by			
XP Solutions		Source Control 2018.1.1			
Summary of Results for 100 year Return Period (+30%)					
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	47.634	0.114	0.9	3.9	O K
60 min Winter	47.658	0.138	0.9	5.1	O K
120 min Winter	47.666	0.146	0.9	5.5	O K
180 min Winter	47.666	0.146	0.9	5.5	O K
240 min Winter	47.661	0.141	0.9	5.2	O K
360 min Winter	47.646	0.126	0.9	4.5	O K
480 min Winter	47.629	0.109	0.9	3.6	O K
600 min Winter	47.614	0.094	0.9	2.9	O K
720 min Winter	47.602	0.082	0.9	2.3	O K
960 min Winter	47.589	0.069	0.9	1.6	O K
1440 min Winter	47.575	0.055	0.7	1.0	O K
2160 min Winter	47.566	0.046	0.5	0.7	O K
2880 min Winter	47.562	0.042	0.4	0.6	O K
4320 min Winter	47.557	0.037	0.3	0.5	O K
5760 min Winter	47.554	0.034	0.3	0.4	O K
7200 min Winter	47.552	0.032	0.3	0.3	O K
8640 min Winter	47.550	0.030	0.2	0.3	O K
10080 min Winter	47.549	0.029	0.2	0.3	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)		
30 min Winter	79.560	0.0	30		
60 min Winter	56.160	0.0	56		
120 min Winter	35.945	0.0	92		
180 min Winter	27.800	0.0	130		
240 min Winter	23.173	0.0	166		
360 min Winter	17.875	0.0	236		
480 min Winter	14.810	0.0	302		
600 min Winter	12.775	0.0	362		
720 min Winter	11.310	0.0	414		
960 min Winter	9.316	0.0	522		
1440 min Winter	7.080	0.0	754		
2160 min Winter	5.366	0.0	1104		
2880 min Winter	4.423	0.0	1460		
4320 min Winter	3.404	0.0	2204		
5760 min Winter	2.860	0.0	2896		
7200 min Winter	2.528	0.0	3664		
8640 min Winter	2.303	0.0	4296		
10080 min Winter	2.142	0.0	5136		
©1982-2018 Innovyze					

INTRADO		Page 3																																	
Castle House 63-69 Cardiff Road CF15 7RD	IR20062 Plymouth House Shared Drive																																		
Date 18/06/2020 17:38 File Shared Drivce.SRCX	Designed by Clare Checked by																																		
XP Solutions																																			
Source Control 2018.1.1																																			
<u>Rainfall Details</u> <table> <tr> <td>Rainfall Model</td> <td>FEH</td> </tr> <tr> <td>Return Period (years)</td> <td>100</td> </tr> <tr> <td>FEH Rainfall Version</td> <td>2013</td> </tr> <tr> <td>Site Location</td> <td>GB 305400 204900 SO 05400 04900</td> </tr> <tr> <td>Data Type</td> <td>Catchment</td> </tr> <tr> <td>Summer Storms</td> <td>Yes</td> </tr> <tr> <td>Winter Storms</td> <td>Yes</td> </tr> <tr> <td>Cv (Summer)</td> <td>0.750</td> </tr> <tr> <td>Cv (Winter)</td> <td>0.850</td> </tr> <tr> <td>Shortest Storm (mins)</td> <td>15</td> </tr> <tr> <td>Longest Storm (mins)</td> <td>10080</td> </tr> <tr> <td>Climate Change %</td> <td>+30</td> </tr> </table> <u>Time Area Diagram</u> Total Area (ha) 0.017 <table> <thead> <tr> <th colspan="2">Time (mins)</th> <th>Area</th> </tr> <tr> <th>From:</th> <th>To:</th> <th>(ha)</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>4</td> <td>0.017</td> </tr> </tbody> </table>			Rainfall Model	FEH	Return Period (years)	100	FEH Rainfall Version	2013	Site Location	GB 305400 204900 SO 05400 04900	Data Type	Catchment	Summer Storms	Yes	Winter Storms	Yes	Cv (Summer)	0.750	Cv (Winter)	0.850	Shortest Storm (mins)	15	Longest Storm (mins)	10080	Climate Change %	+30	Time (mins)		Area	From:	To:	(ha)	0	4	0.017
Rainfall Model	FEH																																		
Return Period (years)	100																																		
FEH Rainfall Version	2013																																		
Site Location	GB 305400 204900 SO 05400 04900																																		
Data Type	Catchment																																		
Summer Storms	Yes																																		
Winter Storms	Yes																																		
Cv (Summer)	0.750																																		
Cv (Winter)	0.850																																		
Shortest Storm (mins)	15																																		
Longest Storm (mins)	10080																																		
Climate Change %	+30																																		
Time (mins)		Area																																	
From:	To:	(ha)																																	
0	4	0.017																																	
©1982-2018 Innovyze																																			

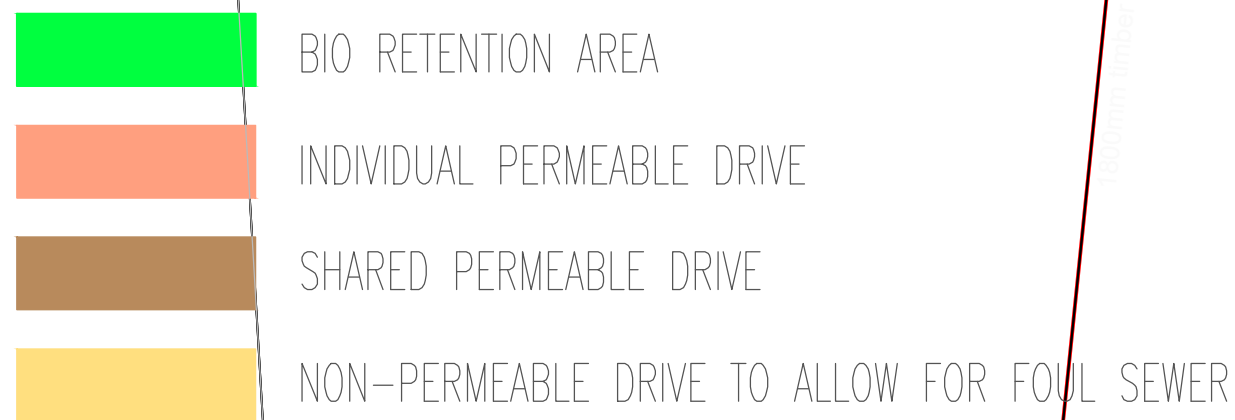
INTRADO		Page 4																								
Castle House 63-69 Cardiff Road CF15 7RD	IR20062 Plymouth House Shared Drive																									
Date 18/06/2020 17:38 File Shared Drivce.SRCX	Designed by Clare Checked by																									
XP Solutions		Source Control 2018.1.1																								
Model Details Storage is Online Cover Level (m) 48.000 Porous Car Park Structure <table><tr><td>Infiltration Coefficient Base (m/hr)</td><td>0.04000</td><td>Width (m)</td><td>4.5</td></tr><tr><td>Membrane Percolation (mm/hr)</td><td>1000</td><td>Length (m)</td><td>37.7</td></tr><tr><td>Max Percolation (l/s)</td><td>47.1</td><td>Slope (1:X)</td><td>500.0</td></tr><tr><td>Safety Factor</td><td>2.0</td><td>Depression Storage (mm)</td><td>5</td></tr><tr><td>Porosity</td><td>0.30</td><td>Evaporation (mm/day)</td><td>3</td></tr><tr><td>Invert Level (m)</td><td>47.520</td><td>Cap Volume Depth (m)</td><td>0.350</td></tr></table>			Infiltration Coefficient Base (m/hr)	0.04000	Width (m)	4.5	Membrane Percolation (mm/hr)	1000	Length (m)	37.7	Max Percolation (l/s)	47.1	Slope (1:X)	500.0	Safety Factor	2.0	Depression Storage (mm)	5	Porosity	0.30	Evaporation (mm/day)	3	Invert Level (m)	47.520	Cap Volume Depth (m)	0.350
Infiltration Coefficient Base (m/hr)	0.04000	Width (m)	4.5																							
Membrane Percolation (mm/hr)	1000	Length (m)	37.7																							
Max Percolation (l/s)	47.1	Slope (1:X)	500.0																							
Safety Factor	2.0	Depression Storage (mm)	5																							
Porosity	0.30	Evaporation (mm/day)	3																							
Invert Level (m)	47.520	Cap Volume Depth (m)	0.350																							
©1982-2018 Innovyze																										

9. Appendix C

Drainage Layout IR20062/100 P1



BIORETENTION AREA WITH INLET



PRELIMINARY

P1	FIRST ISSUE	BP	19.06.20
REV.	DESCRIPTION	BY	DATE

intrado
Consulting Engineers

CARDIFF OFFICE
Castle House, 63/69 Cardiff Road
Taffs Well, Cardiff. CF15 7RD
tel: 02920 811097
web: www.intrado.co.uk
e-mail: admin@intrado.co.uk

client **MR D REES**

project

LAND ADJACENT TO
2 PLYMOUTH HOUSE

drawing title

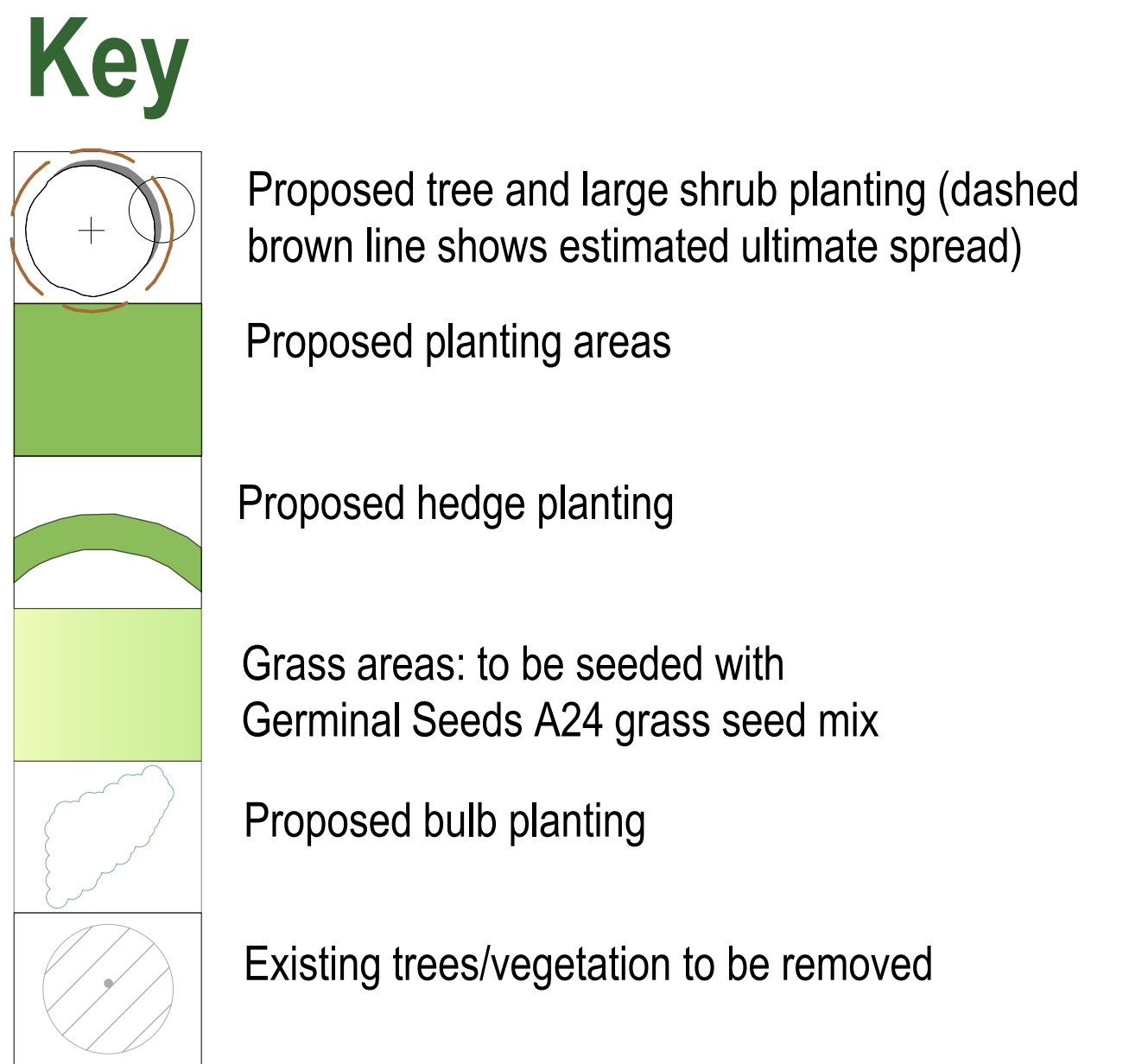
DRAINAGE STRATEGY

drawn BP	chkd CC	scale 1:100@A1	date MAY 2020
-------------	------------	-------------------	------------------

Preliminary ☒	Job No.	Drawing No.	Rev.
Tender ☐	IR20062	SK100	P1
Construction ☐			

10. Appendix D

Landscape Plan



Spacing	ID	No.	Latin Name	Scheduled Size
TREE	AC	3	Acer campestre	Extra Heavy Standard, RB, 14-16cm girth
4/m2	AJCG	27	Ajuga reptans 'Catlin's Giant'	CG, 2L
4/m2	Am	19	Alchemilla mollis	10-20cm, CG, 2L
TREE	CbFF	1	Carpinus betulus 'Frans Fontaine'	Extra Heavy Standard, RB, 14-16cm girth,
1/m2	CdWD	12	Choisya x dewitteana 'White Dazzler'	80-100cm, CG 5L
5/m2	De fern	27	Dryopteris erythrosora	30-40cm, CG, 2L
1/m2	EDS hedge	16	Escallonia 'Donard Seedling'	80-100cm, CG 5L
1/m2	FMP	13	Fuchsia 'Mrs Popple'	80-100cm, CG 5L
TREE	FSP	2	Fagus sylvatica 'Purpurea'	Extra Heavy Standard, RB, 14-16cm girth
4/m2	GR	19	Geranium 'Rozanne'	CG, 2L
SPEC	IaAM	2	Ilex aquifolium Argentea Marginata	150-175cm, CG 15L
SPEC	Iaq	1	Ilex aquifolium	150-175cm, CG 15L
1/m2	LmBb	26	Liriope muscari 'Big Blue'	80-100cm, CG 5L
1/m2	Lp	5	Lonicera pileata	80-100cm, CG 5L
20/m2	NFG-bulb	163	Narcissus February Gold	Grade 12/14
20/m2	NPH-bulb	159	Narcissus Patrick Hackett	Grade 12/14
2.5/linm	Oxh hedge	13	Olearia x haastii	40-60cm, CG, 3L
1/m2	PKD	20	Potentilla fruticosa 'Katherine Dykes'	80-100cm, CG 5L
1/m2	PIAG	2	Pittosporum tenuifolium 'Abbotsbury Gold'	80-100cm, CG 7.5L
1/m2	PxFL	12	Photinia x fraseri 'Louise'	80-100cm, CG 5L
TREE	QROB	1	Quercus robur	Extra Heavy Standard, RB, 14-16cm girth
1/m2	SaH	14	Symphoricarpos chenaultii 'Hancock'	80-100cm, CG 5L
1/m2	SHP	23	Symphytum 'Hidocote Pink'	80-100cm, CG 5L
SPEC	SrSG	1	Sambucus racemosa 'Sutherland Gold'	40-60cm, CG 3L
1/m2	Vd	8	Viburnum davidii	80-100cm, CG 5L
1/m2	VtG hedge	12	Viburnum tinus 'Gwenllian'	80-100cm, CG 5L

General Notes

All Nursery Stock to comply with **BS3936 Part 1:1992** and all subsequent amendments; native species to be of local provenance unless otherwise agreed. The supply and planting of trees to be in accordance with BS 5854:2014;

All Landscape operations to comply with **BS4428:1989** and all subsequent amendments; Any proposed substitutions, whether species, cultivar, pot size or other specification, must be approved by landscape architect prior to planting;

The landscape contractor to make him/herself aware of any underground and overhead services prior to planting.

Topsoil: existing topsoil on site may be reused subject to agreement with the landscape architect. Imported topsoil to be provided as necessary to make up any deficiency in quantity and/or quality. Imported topsoil to be in accordance with **BS3882** multipurpose grade, sandy loam texture.

Subsoil: existing subsoil may be reused in wild flower grassland areas, subject to agreement with the landscape architect.

Tree work

Clearly mark all trees/hedges to be removed. Cut down, chip all arisings less than 75mm dia. for use on site. Cut all larger dia. timber into 2m lengths and stack in agreed locations for removal by others. Work near retained trees: make down trees in small sections to avoid damage to adjacent trees.

Planting generally - plant roots must be protected at all times from sun, frost and winds with planting bags used for all bare root material. All plants to be planted to the root collar and well firmed in the backfill material. Backfill material is to be placed around the roots in such a way as to ensure close contact with the roots.

Immediately after planting cut back any damaged, dead or diseased branches, remove any weak, thin or malformed growth. Water plants thoroughly after planting. Watering to continue as required throughout first growing season following planting.

Tree planting

Tree pits to be excavated to minimum 1000mm diameter and 600mm depth. Clear all vegetation from pit surface. In sloping ground, maintain horizontal bases and vertical sides with no less than minimum depth throughout. Break up bottom of pits to a depth of 150mm and scarify sides. Pits to be backfilled with a well-mixed combination of 2/3 volume topsoil and 1/3 volume peat free compost.

Tree stakes: double stakes for Extra Heavy Standards (EHS), single stakes for Standards and smaller, 75mm dia., two each side/one on single side of tree trunk, driven into base/side of tree at 45 deg, to at least 300mm depth, finished height above ground 700mm. Fix tree firmly but not rigidly to stakes with cushioned tree ties, min. 50mm wide, with spacers between tree and stakes. Spread a 75mm deep (settled) layer of approved bark or wood chip mulch over an area of 1m dia. around each tree position.

- Remove surface vegetation, except trees shown for retention, from areas to be planted. Excavate as necessary to receive 400mm depth topsoil. Break up sub-base to ensure free drainage. Once soil is spread cultivate to 400mm depth, removing stones and rubbish over 75mm dia. Spread a 50mm layer of peat free compost over planting areas and incorporate into top 300mm.
- Plant at densities shown. Native mixes, including hedges, to be planted in a random mix with species groups of 1 to 3. Setting out of plant mix areas to be agreed with landscape architect.
- Spread a 75mm deep (settled) layer of approved bark or wood chip mulch over all plant and hedge mix areas after planting, native mix areas do not require mulch.

Grass Seeding

- Remove all surface vegetation. Cultivate to a depth of 300mm, removing stones and rubbish larger than 50mm dia., grade surface and add a 40mm layer of PAS100 compost into the top 150mm. Grade to smooth flowing contours.
- Reduce the top 25mm to a fine tilth and remove stones and rubbish over 30mm dia. Sow grass seed (Germinal/British Seed Houses A24 Wear and Tear mix or equivalent and approved) at 35g/sq m - in 2 equal sowings in transverse directions. Lightly harrow or rake.
- Sward establishment: first cut of grass when the sward reaches between 40 and 70 mm ht. Remove stones/rubbish over 25mm dia. and cut grass to 40mm ht. Reseed areas of poor establishment until a sward of minimum 95% coverage has been achieved.

- Maintain all planting areas and tree bases free of weeds by chemical and/or mechanical means.
- Remove any dead trees and replace with equivalent size and species in first 5 years after planting. Remove any other dead plants and replace with equivalent size and species in first year after planting.
- Water as necessary to establish plants successfully.
- Check stakes and ties and adjust to avoid damage to trees. Refirm any plants which have worked loose. Replace stakes/ties as necessary and check tree ties regularly. Prune plants according to species, location and season to remove damaged/dead growth and to encourage healthy growth with a well-balanced natural appearance .
- Maintain mulch at 75mm depth.

FIONA CLOKE A S S O C I A T E S landscape architecture environmental planning			
Brynant, Soar, Brecon, Powys, LD3 9LT fc@fionacloke.co.uk www.fionacloke.co.uk 07760 471318			
Client Mr D Rees			
Project Plymouth House, Merthyr Tydfil			
Drawing Title Planting Plan			
Date 19.10.19	Drawn FEC	Scale 1:200 @ A1	
Project No 712	Drawing No 01	Rev	