t 01205 317540 f 01205 317400
w www.jcconsultancyltd.com
e info@jcconsultancyltd.com

✉ Morgan House, Gilbert Drive,
Boston, Lincolnshire, PE21 7TQ

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PERCOLATION TEST RESULTS & SOAKAWAY DESIGN

AT

12 MAY 2014

NEW DWELLING,
BRADFORD ROAD,
BOSTON,
LINCOLNSHIRE
PE21 8BJ

FOR

YARBOROUGH DEVELOPMENTS

JOB NO.
JC/13/11/1581

DOCUMENT REF;- JC/13/11/1581-PT

CALCS BY;-
JLH
FEB 2014

INTERNAL CHECKS BY;-
J.C.ELLINGTON BSc. CEng, MIStructE, FRSA, MInstD.
FEB 2014

CALCULATION STATUS
BUILDING REGULATION APPROVAL

CONTENTS

t 01205 317540
f 01205 317400
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Structural Calculations

Job	Percolation Test Results & Soakaway Design Calculations;- Proposed Development at Bradford Road, Boston, Lincolnshire.	
Job No.	JC/13/11/1581	
Client	Yarborough Developments	
Architect / Agent	Nick Overton	
Design Codes	BS EN 752 : Part 2	Drain & Sewer Systems outside Buildings
	BRE Digest 365	Soakaway Design
	CIRIA Report 156	Infiltration Drainage – Manual of Good Practice
	Approved Doc H	Drainage & Waste Disposal.
	Guidance Note 46	Surface Water Soakaway Design (LBC)

Existing Info

Design based on drawings prepared by Architect (Provided by Client) together with site observations taken by JC Consultancy Ltd Engineer.

Traditional Soakaways proposed as;-

1) Investigation and Ground Investigation reports indicate ground strata to be predominantly silts and silty clays.

2) Dwelling is relatively small and compact resulting in area to be drained < 100m^2

Design Brief

Suitable soakaways to be designed to store immediate storm water run off and allow for the waters efficient infiltration into the adjacent soil.

Design Philosophy

Percolation tests carried out in accordance with Design Guidance noted above in order to provide Soil Infiltration Rates.

Data used in accordance with BRE Digest 365 in order to design suitable Soakaways.

Scope of Works.

Only the Items discussed within the Design Brief and Design Philosophy, and listed in the contents have been considered as part of this calculation package. Therefore, this calculation package does not include any other structural items.

Any further items, outside the Scope of works should be carried out in accordance with Architects / Suppliers / Contractors specifications and Local Authority recommendations.

This calculation package should be read in conjunction with other Site Investigation Reports, geotechnical and ground contamination reports available for the site.

COMMENT	CALCULATION	OUTPUT

SURFACE WATER SOAKAWAY DESIGN;-

PERCOLATION TESTS;-

LENGTH OF TRIAL PIT = 350 mm

WIDTH OF TRIAL PIT = 350 mm

DEPTH OF TRIAL PIT = 600 mm (BELOW AROP. INVERT)

FREE VOLUME = 100 % (NO FILL USED).

TEST 1 = TIME TO FALL 75% TO 25% = 22 MIN

TEST 2 = TIME TO FALL 75% TO 25% = 26 MIN

TOT 3 = TIME TO FALL 75% TO 25% = 34 MIN.

FOR SOAKAWAY DESIGN - IMPERMEABLE AREA;-

(FROM ROOF) = 140 m^2

USING AQUACELL 'CORE' SYSTEM BY WAVIN PRODUCTS

DELIVERING 95% VOID VOLUME

TRY A 5.0m x 1.0m x 0.8m SOAKAWAY

SEE BRE 365 DESIGN OVER.

SOAKAWAY DESIGN

In accordance with BRE Digest 365 - Soakaway design

Tedds calculation version 2.0.01

Design rainfall intensity

Location of catchment area	Other
Impermeable area drained to the system	A = **140.0** m²
Return period	Period = **100** yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = **0.450**
5-year return period rainfall of 60 minutes duration	M5_60min = **20.0** mm
Increase of rainfall intensity due to global warming	$p_{climate}$ = **20** %

Soakaway / infiltration trench details

Soakaway type	Rectangular
Minimum depth of pit (below incoming invert)	d = **800** mm
Width of pit	w = **1000** mm
Length of pit	l = **5000** mm
Percentage free volume	V_{free} = **95** %

Soil infiltration rate (BRE digest 365)

Length of trial pit	l_{trial} = **350** mm
Width of trial pit	b_{trial} = **350** mm
Depth of trial pit (below invert)	d_{trial} = **600** mm
Free volume (if fill used)	V_{trial} = **100** %
75% depth of pit	$d_{75} = (d_{trial} \times 0.75)$ = **450.00** mm
50% depth of pit	$d_{50} = (d_{trial} \times 0.50)$ = **300.00** mm
25% depth of pit	$d_{25} = (d_{trial} \times 0.25)$ = **150.00** mm
Test 1 - time to fall from 75% depth to 25% depth	T1 = **22** min
Test 2 - time to fall from 75% depth to 25% depth	T2 = **26** min
Test 3 - time to fall from 75% depth to 25% depth	T3 = **34** min
Longest time to fall from 75% depth to 25% depth	t_{lg} = max(T1, T2, T3) = **34** min
Storage volume from 75% to 25% depth	$V_{p75\_25} = (l_{trial} \times b_{trial} \times (d_{75} - d_{25})) \times V_{trial}$ = **0.04** m³
Internal surface area to 50% depth	$a_{p50} = ((l_{trial} \times b_{trial}) + (l_{trial} + b_{trial}) \times 2 \times d_{50})$ = **0.54** m²
Surface area of soakaway to 50% storage depth	$A_{s50} = 2 \times (l_{trial} + b_{trial}) \times d_{trial} / 2$ = **0.420** m²
Soil infiltration rate	$f = V_{p75\_25} / (a_{p50} \times t_{lg})$ = **33.2×10⁻⁶** m/s
Wetted area of pit 50% full	$a_{s50} = l \times d + w \times d$ = **4800000** mm²

Table equations

Inflow	$I = M10 \times A$
Outflow	$O = a_{s50} \times f \times D$
Storage	$S = I - O$

Duration, D (min)	Growth factor Z1	M5 rainfalls (mm)	Growth factor Z2	10 year rainfall, M10 (mm)	Inflow (m³)	Outflow (m³)	Storage required (m³)
5	0.39	8.6	1.21	10.4	1.46	0.05	1.41
10	0.54	11.9	1.23	14.6	2.04	0.10	1.95
15	0.65	14.3	1.24	17.7	2.48	0.14	2.33

j c consultancy consulting structural & civil engineers JC Consultancy Limited info@jcconsultancyltd.com	Project New Dwelling, Bradford Road, Boston				Job no. JC1581	
	Calcs for Soakaway Design				Start page no./Revision : 6	
	Calcs by JH	Calcs date Feb 2014	Checked by JCE	Checked date Feb 2014	Approved by CN	Approved date Feb 2014

Duration, D (min)	Growth factor Z1	M5 rainfalls (mm)	Growth factor Z2	10 year rainfall, M10 (mm)	Inflow (m^3)	Outflow (m^3)	Storage required (m^3)
30	0.82	18.0	1.24	22.4	3.13	0.29	2.84
60	1.00	22.0	1.24	27.3	3.82	0.57	3.25
120	1.19	26.2	1.24	32.3	4.53	1.15	3.38
240	1.38	30.4	1.22	37.0	5.18	2.30	2.89
360	1.51	33.2	1.21	40.2	5.63	3.44	2.19
600	1.68	37.0	1.20	44.3	6.20	5.74	0.47
1440	2.03	44.7	1.18	52.7	7.38	13.77	0.00

Required storage volume S_{req} = **3.38** m^3

Soakaway storage volume $S_{act} = l \times d \times w \times V_{free}$ = **3.80** m^3

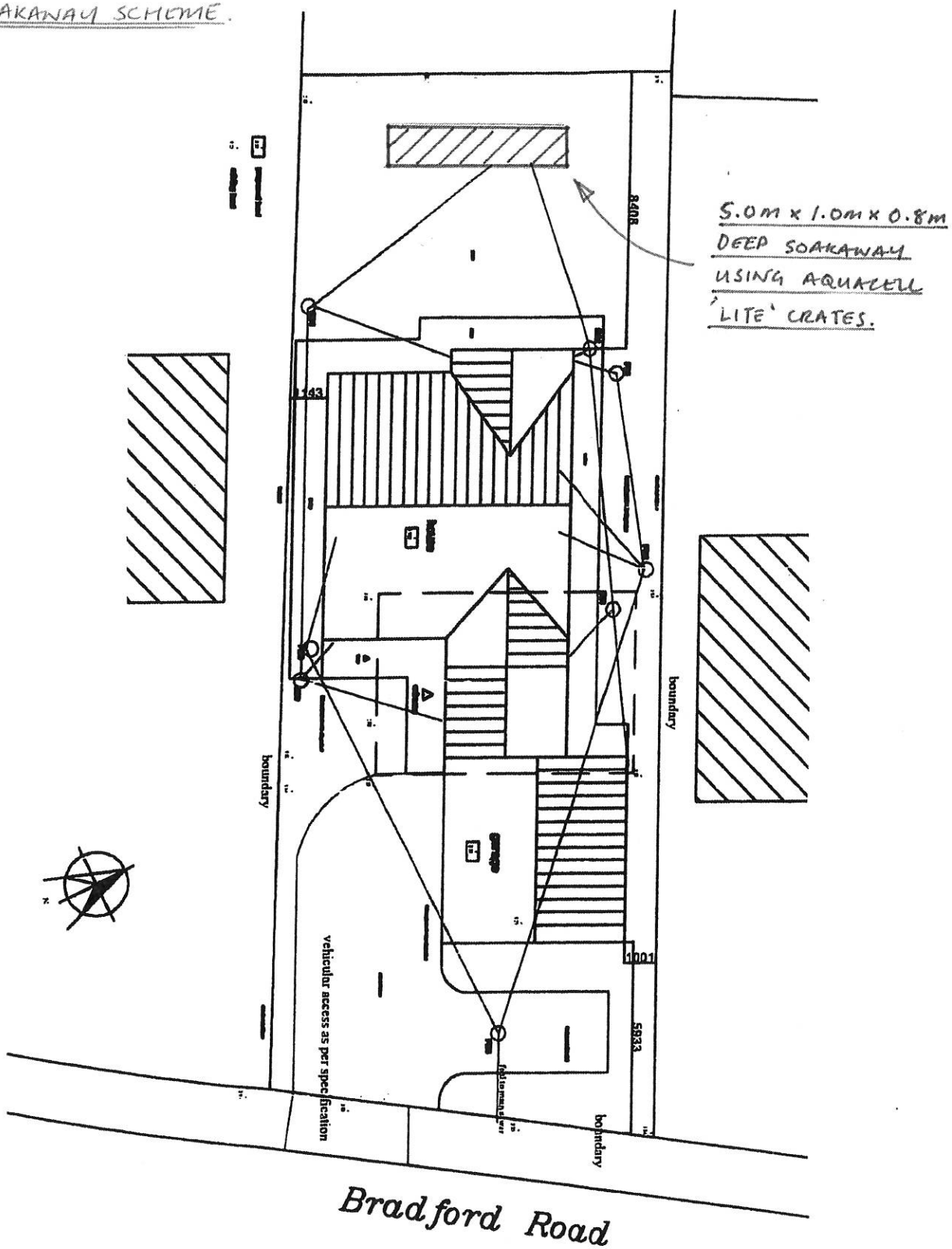
PASS - Soakaway storage volume

Time for emptying soakaway to half volume $t_{s50} = S_{req} \times 0.5 / (a_{s50} \times f)$ = 2hr 56min 43s

PASS - Soakaway discharge time less than or equal to 24 hours

j c consultancy LTD consulting structural & civil engineers DETAIL SHEET	CONTRACT / PROJECT New Dwelling;- Bradford Road, Boston, Lincolnshire PE21 8BJ	JOB No. JC/13/11/1581 PAGE 7 DATE Jan 2014 BY JLH CHKD JCE

SOAKAWAY SCHEME.



General Introduction

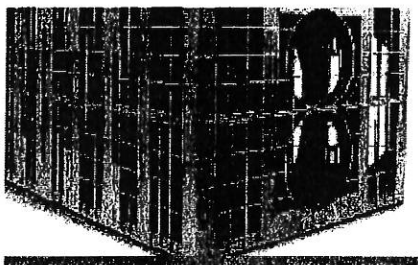
The development of sites results in a large proportion of area being covered by impermeable surfaces such as roofs, car parks and roads. Surface water run-off therefore increases up to 80%. Regulators (Environment Agency, Scottish Environment Protection Agency and local authorities) are promoting the use of Sustainable Drainage Systems (SUDS) that control run-off to that of a greenfield site (around 20%).

The Intesio Stormwater Infiltration and Attenuation Systems have been developed to provide a method of source control in two ways:

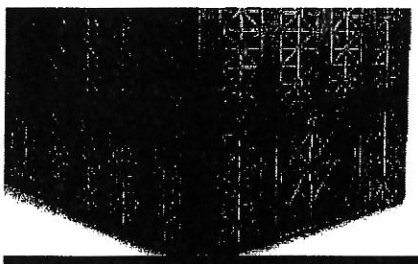
- By providing temporary storage for excess flows and limiting outflow to streams and rivers.
- By providing soakaways to infiltrate stormwater back into the ground.

The modular nature of the Intesio Stormwater Infiltration and Attenuation Systems means that they can be tailored to suit the specific requirements of each site. They can be used to provide temporary storage, attenuation and infiltration capacity for run-off for all sizes and types of site: from individual houses up to the largest commercial developments.

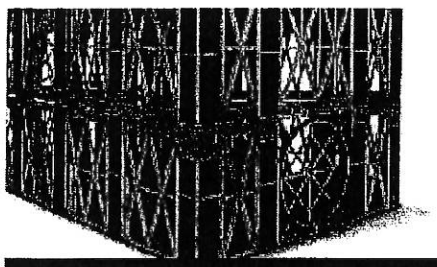
Infiltration and Attenuation Systems



AquaCell Plus



AquaCell Core



AquaCell Lite

Intesio AquaCell® Systems:

The AquaCell systems are a fully tried and tested modular technique for managing excessive rainfall by creating an underground structure as either a temporary storage tank or a soakaway:

- **AquaCell Plus** (light blue unit) inspectable, for use in deep/trafficked locations
- **AquaCell Core** (blue unit) for trafficked locations
- **AquaCell Lite** (green unit) for landscaped and non-trafficked sites

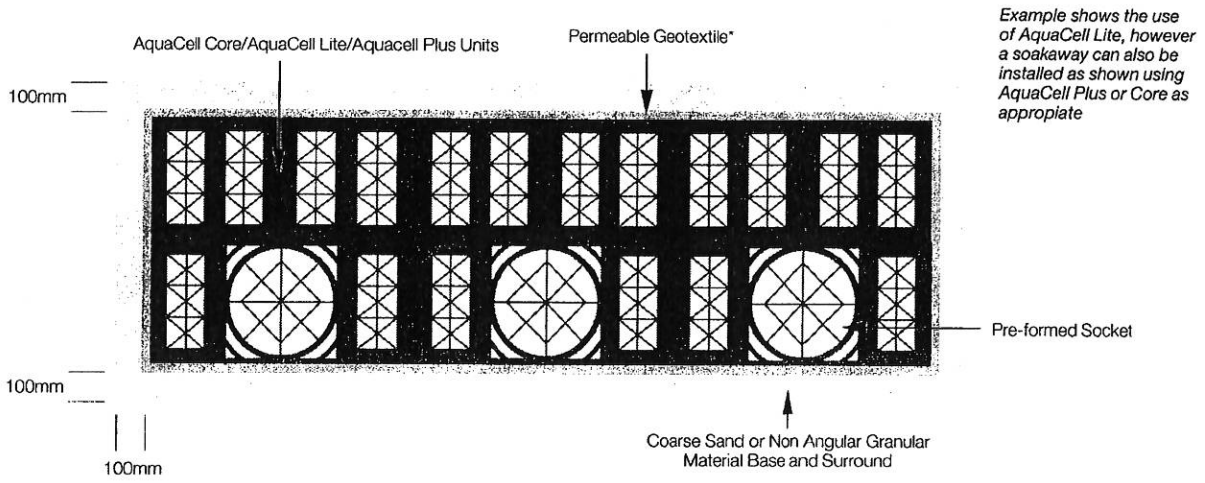
Box systems – select with care

Rising rainfall levels, and increased focus on SUDS compliance, have led to a sharp increase in the use of modular box systems to create underground structures for infiltration or temporary storage of stormwater.

However, not all currently available systems have the proven performance characteristics necessary for the wide range of complex underground geocellular applications (see pages 8, 9, 10 & 11).

With **Intesio AquaCell systems**, however, the required strength and hydraulic capabilities have been verified by independent testing.

Typical Soakaway Installation Method



Example shows the use of AquaCell Lite, however a soakaway can also be installed as shown using AquaCell Plus or Core as appropiate

1. Excavate the trench to the required depth ensuring that the plan area is slightly greater than that of the AquaCell units.
2. Lay 100mm bed of coarse sand or non angular granular material, level and compact.
3. Lay the geotextile* over the base and up the sides of the trench.
4. Lay the AquaCell units parallel with each other. In multiple layer applications, wherever possible, continuous vertical joints should be avoided. AquaCell units can be laid in a 'brick bonded' formation (i.e. to overlap the joints below). For single layer applications use the AquaCell Clips and for multi layers use the AquaCell Clips and the AquaCell Shear Connectors.
5. Fix the Adaptors to the AquaCell units as required and connect pipework.
6. In order to prevent silt from entering the tank, clogging inlet pipework and reducing storage capacity, it is recommended that the Silt Trap (6LB600) is installed prior to the inlet pipework - see page 18 for installation guidelines.
7. Wrap and overlap the geotextile covering the entire AquaCell structure.
8. Lay 100mm of coarse sand or non angular granular material between the trench walls and the AquaCell structure and compact.
9. Lay 100mm of coarse sand or non angular granular material over the geotextile and compact. Backfill with stone free as-dug material.
10. Rainwater from roof areas may discharge directly into the soakaway but rainwater from carparks must discharge through a catchpit manhole or a petrol interceptor.

** The geotextile should be selected according to specific site conditions, however, typically a 300g material will be suitable. Specialist advice should be sought if surrounding soil characteristics exhibit a high degree of fines/low infiltration capacity and/or there is a high risk of damage from ground contaminants.*

t 01205 317540
f 01205 317400
w www.jcconsultancyltd.com
e info@jcconsultancyltd.com

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Additional Soakaway Notes;-

1) Soakaways to be designed and constructed in accordance with the following documentation;-

BS EN 752 : Part 2	Drain & Sewer Systems outside Buildings
BRE Digest 365	Soakaway Design
CIRIA Report 156	Infiltration Drainage – Manual of Good Practice
Approved Doc H	Drainage & Waste Disposal.
Guidance Note 46	Surface Water Soakaway Design (LBC)

2) Soakaways should be located a minimum of 5 Metres from any buildings (including buildings located over the boundary line)

3) Soakaways should not be located within 2.5 Metres of a boundary or in an area of unstable land in ground where the water table reaches the bottom of the soakaway at any time of the year, near any drainage field, drainage mound or other soak-away so that the overall soakage capacity of the ground is exceeded and the effectiveness of any drainage field impaired.

4) Soakaways have been designed to suit the investigated ground strata. If differing strata is uncovered during the works, the Engineer is to be informed in order to provide re-design if required.

5) Any soakaway depth indicated within the design package is measured from the underside of the discharge drain pipe (invert)

6) If used, granular material and rubble fill must be separated from the surrounding soil by a suitable geotextile to prevent migration of fines into the soakaway. The top surface of granular material and rubble fill should also be covered with geotextile to prevent the ingress of backfill material.

7) Any Aquacell products specified are to be installed in strict accordance with manufacturers requirements.